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WAR DEPARTMENT TECHNICAL MANUAL

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PASSAGE OF OBSTACLES OTHER THAN MINE FIELDS

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WAR DEPARTMENT • JULY 1945

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This manual supersedes TB ENG 2, 24 December 1943, TB ENG 4, 12 January 1944, TB ENG 8, 5 February 1944, including C 1, 1 March 1944, TB ENG 30, 30 June 1944, TB ENG 34, 15 August 1944, and TB ENG 60, March 1945.

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Refer to FM 21-6 for explanation of distribution formula.

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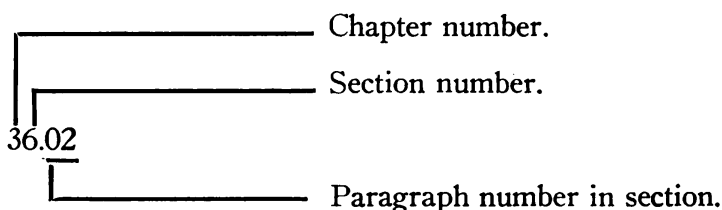
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FOREWORD

This manual contains in loose-leaf form the latest information on passage of obstacles other than mine fields. As new items of equipment and new techniques are developed loose-leaf changes will be issued.

For convenience in adding new material to this manual, the following numbering system is used:

Paragraphs. Paragraphs are numbered by a decimal system to indicate chapter, section, and paragraph as shown below:



The number shown in the example is chapter 3, section VI, paragraph 2.

Illustrations. Illustrations in this manual are numbered the same as paragraphs. For example, figure 43.02*b* is the second illustration in chapter 4, section III, paragraph 2.

Pages. Pages are numbered consecutively, without reference to the paragraphs contained thereon. Pages added through changes or additions to the manual are indicated by letter. For example, if material is added between pages 62 and 63, the material is issued on page 62*a*.

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CHAPTER I

GENERAL

Section I. INTRODUCTION

11.01. Purpose and Scope

This Technical Manual describes devices and techniques useful in the passage of obstacles other than mine fields. It details engineer and other methods of passing such obstacles, and describes issue, special and improvised equipment, including its assembly, employment, and effectiveness. Special applications of standard weapons and techniques are included. Chapters 1, 2, and 3 cover passage of land obstacles; chapter 4 deals with underwater and beach obstacles.

11.02. References

Obstacles are described in FM 5-15; general demolition technique in FM 5-25; and tactics of breaching obstacles in FM 5-6. Mine fields and the passage of mine fields are described in FM 5-31. The basic tactics and doctrine for landing operations are set forth in FM 31-5, and in Landing Operations Doctrine, U. S. Navy (FTP-167).

Section II. GENERAL DISCUSSION

12.01. General

Successful passage of obstacles depends on accurate knowledge of the tactical situation, proper use of intelligence information, thorough reconnaissance, technically correct use of explosives and special equipment, detailed planning and preparation, and frequent rehearsals.

12.02. Methods of Passage

Methods used to breach obstacles vary with the situation, depending on the need for speed and silence, presence of enemy fire, availability of special equipment and explosives, and number of troops in the area who might be injured by falling debris. For the purposes of this manual, methods of forcing passage are divided into three general groups:

a. EXPLOSIVE MEANS OF DISPOSING OF OBSTACLES (ch. 2). (1) Demolition by hand-placed or mechanically-placed explosive charges is the most effective method. Effective means of breaching obstacles with hand-placed charges are illustrated in figures 21.01*a* to 22.03 inclusive, and 31.02*a*. Placement of charges by mechanical means is shown in figures 23.02*a* to 23.11*b* inclusive, and 31.05*a* to 31.07*c* inclusive.

(2) Destruction of obstacles by tank gunfire or artillery fire requires much ammunition in proportion to results obtained. Rocket fire using 7.2-inch demolition rockets is generally more effective than artillery fire but is used only at extremely short ranges.

b. MECHANICAL MEANS OF DISPOSING OF OBSTACLES (ch. 3). (1) Small obstacles can be breached with mechanical equipment such as the tank bulldozer. This method is rapid and effective and can be employed safely in the face of small-arms fire.

(2) Most obstacles can be surmounted quietly and fairly quickly. However, bulky equipment and large carrying parties may be required to make a crossing for vehicles.

(3) Hand removal can be used only against limited types of obstacles, and it takes considerable time during which the working party is exposed to fire.

c. MEANS OF DISPOSING OF UNDERWATER AND BEACH OBSTACLES (ch. 4). Passage of underwater and beach obstacles is covered in a separate part of this manual because it poses a separate problem requiring special equipment and special techniques.

12.03. Characteristics of Gap

Characteristics of a suitable gap depend on whether tracked or wheeled vehicles are to use it. Tanks will pass through gaps too rough for wheeled vehicles to negotiate. The minimum width of gap for all vehicles is 15 feet.

12.04. Gap Marking

The unit responsible for breaching an obstacle is also responsible for marking the resulting gap. Methods of marking gaps through land obstacles are the same as those discussed in FM 5-31 for mine-field gaps.

Section III. TYPICAL OBSTACLES AND METHODS OF PASSING THEM

13.01. General

This section briefly describes the land obstacles most likely to be encountered and outlines the principal methods used to breach or pass each type

obstacle. The equipment and methods referred to in this section are described in detail under separate headings in chapters 2 and 3.

13.02. Barbed Wire

Barbed-wire entanglements are built as high fences, as deep, low entanglements, or as a combination of both. The enemy frequently erects more than one band of wire and uses mines and alarm devices. The following breaching methods are suitable:

a. BANGALORE TORPEDOES. Bangalore torpedoes make a clear, usable gap. (See par. 22.03.) They cut antipersonnel-mine trip wires as well as the barbed wire.

b. SURMOUNTING. Assaulting foot troops using canvas mats, chicken wire, or other suitable material can surmount obstacles rapidly and silently if antipersonnel mines are not present.

c. CRAWLING UNDER OR THROUGH. Crawling under or through wire entanglements is a silent but slow method used in the first phase of an operation when secrecy must be preserved.

d. WIRE CUTTERS. Search-nose wire cutters can be used to cut a path through a deep entanglement, but this takes considerable time.

e. VEHICLES. In the latter phases of a breaching operation, it may be necessary to remove entire sections of wire entanglements. This can be done using rope or cable attached to tanks or trucks or using the winch cable on half-tracks or trucks. Wire can be cleared rapidly by pushing it out with a bulldozer blade.

f. BOMBARDMENT. Artillery or aerial bombardment or rocket fire cannot be depended on to provide a completely cleared path; however, such fire lessens the tasks of assault troops. These methods leave mines adjacent to cleared areas in a sensitive state.

g. SNAKE. Demolition snakes breach a path approximately 80 feet wide through barbed wire and clear a path through mines wide enough for passage of vehicles.

13.03. Small Concrete Obstacles

Concrete obstacles vary considerably in size, shape, quality of concrete, amount and type of reinforcing, spacing, total depth of the group of obstacles, and type of ground in which they are emplaced. Characteristic obstacles are posts, coffins, cubes, cylinders, eggs, dragon's teeth connected by concrete ground sills, and tetrahedrons of plain or reinforced concrete. The following methods are used to pass them:

a. TANK BULLDOZER. Bulldozers and tank bulldozers can push aside small obstacles and build earth ramps over dragon's teeth and similar obstacles which cannot be moved.

b. HAND-PLACED CHARGES. If mechanical means are not available, or

if their use will cause undue delay, hand-placed explosive charges are used effectively.

c. TANK, ARTILLERY, AND ROCKET FIRE. Accurate artillery and tank gunfire is effective at point-blank range. Demolition rockets reduce individual concrete obstacles of the size normally encountered.

d. DEMOLITION SNAKE. Demolition snakes can be used to clear lanes through small concrete obstacles; however, a single snake may not clear a suitable gap through cubes or dragon's teeth.

13.04. Log Obstacles

A field of log posts can be constructed using heavy logs embedded in the ground with ends projecting 2 to 4 feet. Log ramps and earth-filled log cribs are also used. These obstacles are disposed of by—

a. HAND-PLACED CHARGES. Hand-placed charges are most commonly used to demolish log obstacles.

b. ROCKET FIRE. Demolition rockets can be used to clear log obstacles.

c. TANK BULLDOZER. The bulldozer or tank bulldozer is used to uproot or break off log posts and push aside log ramps.

d. DEMOLITION SNAKE. Demolition snakes can be used to clear a lane through a field of log posts.

13.05. Steel Obstacles

Steel obstacles which may be encountered are rails, tetrahedrons, hedgehogs, fence type obstacles such as element C, and curved-rail obstacles. They are cleared by—

a. HAND-PLACED CHARGES. Hand-placed charges are effective in breaking down steel obstacles.

b. VEHICLES. Bulldozers and tank bulldozers can push aside tetrahedrons and hedgehogs and ramp over curved-rail obstacles which cannot be moved. They break steel rails or push them aside. In the later phases of a breaching operation, individual steel obstacles can be pulled aside with rope or cable attached to tanks or trucks, or with the winch cable of half-tracks or trucks.

c. ROCKET FIRE. Demolition rockets can be used to demolish steel obstacles.

d. DEMOLITION SNAKE. Demolition snakes can be used to clear a path through rail fields.

e. ACETYLENE TORCH. Acetylene torches can be used in clearing steel obstacles in the later stages of passage.

13.06. Walls

Concrete, masonry, stone, coral, stump, or log walls vary considerably in thickness, height, and shape, and they may or may not be back-filled. Concrete walls vary considerably in quality of concrete and reinforcing.

These factors closely affect the difficulty of the breaching problem. The following methods and equipment are used to breach walls:

a. HAND-PLACED CHARGES. Hand-placed charges are generally used to breach walls for passage of tanks.

b. DOZER-CARRIED CHARGE PLACER. An explosive charge heavy enough to breach an antitank wall can be carried and dropped in position by the dozer-carried charge placer. The charge is quickly placed and fired without exposing personnel.

c. SURMOUNTING. Walls can be surmounted by the following methods:

(1) A tank bulldozer or bulldozer can be used to build a ramp across the wall.

(2) Walls can be ramped with steel treadways.

(3) Walls can be crossed by personnel by scaling or by ramping with hand-carried ramps.

d. ROCKET FIRE. Demolition rockets can destroy an antitank wall rapidly.

13.07. Antitank Ditches

Antitank ditches are usually triangular, rectangular, or trapezoidal in cross-section and have a low parapet on the defender's side. Their dimensions vary and they are often revetted and sometimes contain water. The following methods are suitable for crossing ditches:

a. SURMOUNTING. Ditches are most quickly crossed by using special bridging equipment such as M1 or M2 steel treadways launched by treadway trucks or tank-recovery vehicles.

b. FILLING. Bulldozers or tank bulldozers can fill ditches quickly. Hand tools can be used to break down the sides of the obstacles when the earth is not too hard or the revetment too strong. Corduroy, wire, or steel netting can be used to provide better footing for vehicles passing through the ditch.

c. HAND-PLACED CHARGES. Hand-placed charges can sometimes be used for blowing in sides of antitank ditches. Work with hand tools is generally necessary to make the crossing passable.

d. DEMOLITION SNAKE. An antitank ditch excavated in earth can be made passable by detonation of a demolition snake.

CHAPTER 2

EXPLOSIVE MEANS OF DISPOSING OF OBSTACLES

Section I. HAND-PLACED CHARGES

21.01. General

Demolition by hand-placed explosive charges is the most common method of removing obstacles in an assault. Each job should be planned so the explosives are placed and fired as quickly as possible. Work at the obstacles should consist of these steps only: placing packaged explosive charges on the obstacles, tying charges to obstacles where necessary, connecting explosive charges to detonating-cord ring main, attaching detonating assemblies to main, and arming or actuating the firing circuit. FM 5-25 contains basic instructions and information on the use of explosives. The following principles apply particularly in assault work:

a. CHOICE OF EXPLOSIVES. Tetrytol and plastic-explosive demolition blocks and the Navy Mark 20 demolition charge (par. 43.01a(2)), are most suitable for assault demolitions, because they are conveniently packaged and are more powerful than TNT. Plastic explosive is well suited for demolishing steel obstacles because it can be molded around the obstacle, giving close contact with the steel.

b. PACKAGING CHARGES. Before the operation explosives should be packaged or tied together in quantities varying with the size and type of obstacles to be demolished. Wire, marlin, or sash cord should be attached to the packages so they can be quickly fastened to the obstacles. Thus, when only TNT is available and 15-pound charges are required to demolish a series of small concrete obstacles, 15 pounds of TNT blocks are placed in sandbags and tied with marlin into compact rectangular packages.

c. CONNECTING CHARGES. When a number of separate charges are to be fired simultaneously, they are tied to a detonating-cord ring main so they will be fired by the detonating wave traveling around the main in either direction. The detonating-cord main must not have reverse curves like those shown in figure 21.01a, an actual trial of which resulted in failure. If necessary to place charges on obstacles not close to the

detonating-cord main, additional detonating-cord leads should be connected to the main. (See fig. 21.01b.)

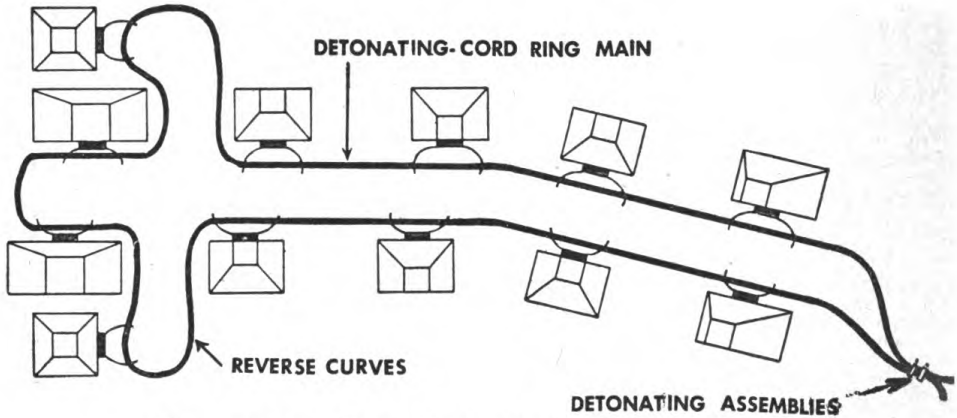


Figure 21.01a. Detonating-cord ring main which failed.

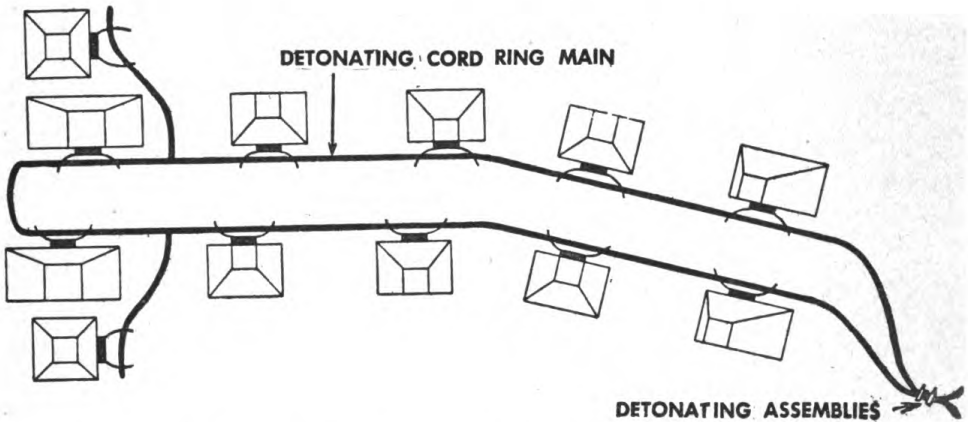


Figure 21.01b. Correct method of connecting charges.

d. PRIMING. If packaged charges are primed beforehand with 3-foot lengths of detonating cord, a series of separate charges can be quickly attached to a detonating-cord ring main. The only work necessary at the obstacle is connecting the leads to the main with a detonating-cord clip or tying the lead and main together with a girth hitch. No blasting cap is required in priming M1 chain demolition blocks, blocks being easily connected to a detonating-cord ring main by tying a length of detonating cord between the ring main and the detonating cord passing through the block. When M2 demolition blocks are used, a blasting cap must be crimped on the end of the detonating cord and secured in the cap well with a priming adapter. The cap should be tied in place if priming adapters are not available. With plastic explosive, an overhand knot is tied in a bight in one end of the detonating-cord lead, the plastic-explosive block is cut open, the knot placed in the middle of the block, and the block remolded into shape.

e. **PREPARING DETONATING ASSEMBLY.** (1) To save time, detonating assemblies, consisting of an M2 weatherproof fuse lighter, required length of time fuse, blasting cap, and a 3-foot length of detonating cord, are made up before the breaching operation. After the charges are placed on the obstacles and connected to the ring main, the detonating assemblies are tied to the main by a square knot or girth hitch. To insure detonation, two assemblies are used on each firing circuit.

(2) Where a short delay in firing is suitable, the 15-second delay detonator is used.

f. **WARNING SIGNALS.** Casualties to friendly personnel caused by falling debris must be avoided. Troops in the vicinity should be warned of an explosion by colored smoke grenades, flag signals, or by firing at a prearranged time.

21.02. Small Concrete Obstacles

a. **QUANTITY OF EXPLOSIVES.** Figure 21.02 shows number and placement of tetrytol packs for destruction of typical small reinforced-concrete obstacles. A general rule for demolishing reinforced-concrete obstacles not shown in figure 21.02 is to use 2 pounds of explosive per cubic foot of concrete. This rule applies to all military explosives, and its use results in a charge sufficient to destroy a well-reinforced, good-quality concrete obstacle of any size or shape. One pound of explosive is used per cubic foot of plain concrete.

b. **THICKNESS OF CHARGE.** To get the most out of each pound of explosive, the greatest area of contact between the obstacle and the explosive should be attained, and the thickness of small charges should not exceed 4 inches.

c. **PLACING.** The charge is placed on the ground against the center of the largest face of the obstacle so there is good contact between explosive and obstacle. The charge may have to be propped against the obstacle or tied in place. Where possible, the charge should be placed on one side of the obstacle so debris is thrown to the side and out of the cleared gap.

d. **FIRING CIRCUIT.** To insure detonation the charge on each obstacle should be connected to the main with two detonating-cord leads.

e. **BREACHING PROCEDURE.** The following breaching procedure is effective when using 20-pound tetrytol packs against obstacles less than 10 cubic feet in volume. If larger obstacles are expected, two or more packs of tetrytol per obstacle are used and more men may be required.

(1) *Equipment.* Equipment includes as many 20-pound packs of tetrytol as there are obstacles, a length of detonating cord about $2\frac{1}{2}$ times the depth of the obstacle, two 45-second-delay detonating assemblies.

(2) *Organization of party.* The party is made up of as many men as there are obstacles, an assistant squad leader, and the squad leader. The

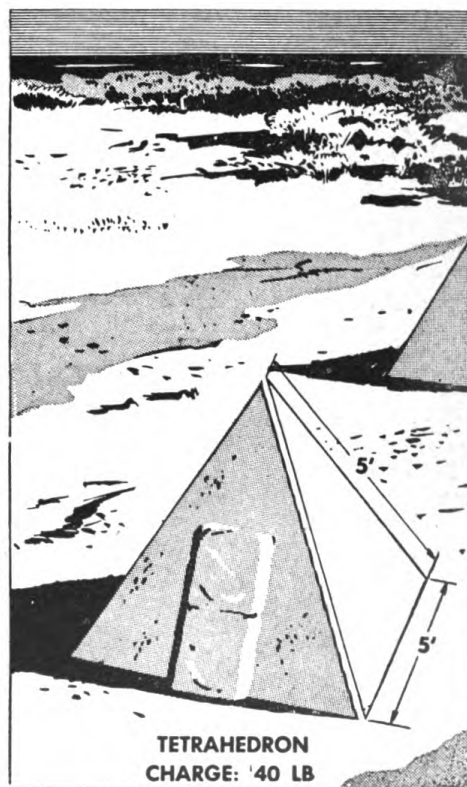
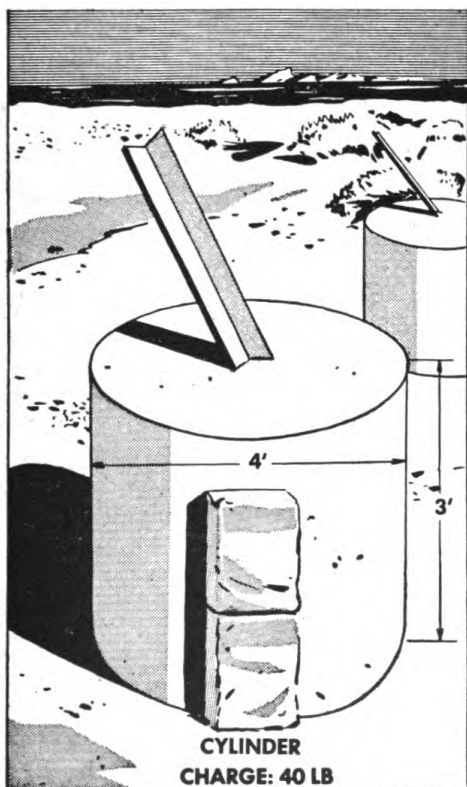
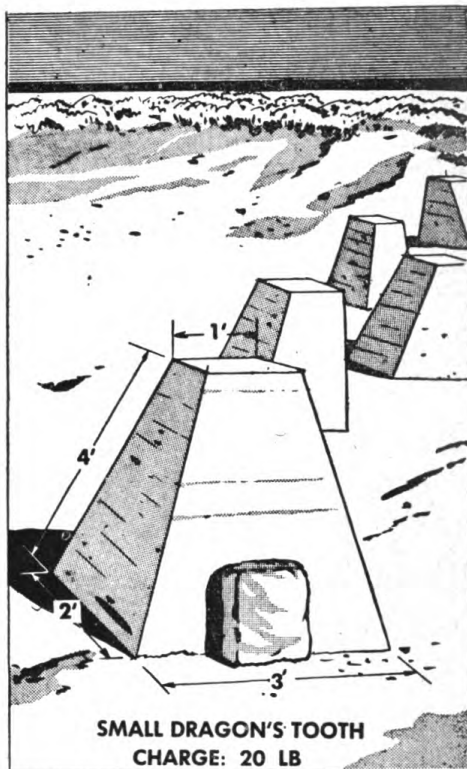
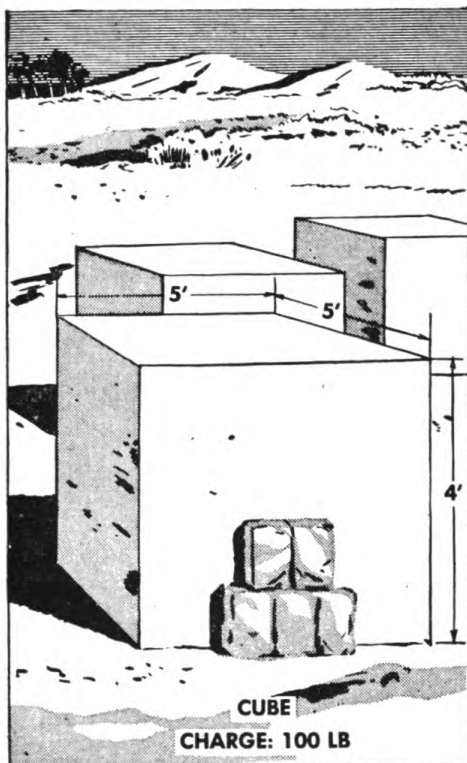


Figure 21.02. Tetrytol packs needed to destroy typical small concrete obstacles.

men in the squad are numbered 1, 2, 3, etc., excluding the squad leader and assistant squad leader.

(3) *Procedure.* (a) Before breaching the obstacle, one or two men may be sent on a reconnaissance to locate and disarm antipersonnel mines. Barbed wire which would interfere with the work of placing and tying charges may also be cleared beforehand, although the charges are often placed through the wire rather than forfeit surprise. Detonation of the explosive will eliminate both wire and antitank obstacles. Such an operation against a three-row concrete-coffin installation combined with a 30-foot-deep barbed-wire fence can be completed in 6 minutes.

(b) The squad crawls to within 30 yards of the obstacles. Each man carries his explosive charge and keeps 10 yards from the man nearest him. The squad leader then grasps the center of the detonating-cord main, runs between the obstacles letting the two free ends trail behind him, and drops the detonating cord at the farthest obstacle.

(c) The No. 1 and No. 2 men follow the squad leader: No. 1 man works on the farthest obstacle on the left of the path to be cleared; No. 2 man on the farthest obstacle on the right. Each man places his tetrytol pack on the ground and centers it close against the face of the obstacle so that when the charge is fired the obstacle is thrown outward to the side. He then connects the two detonating-cord leads of the tetrytol packs to the detonating-cord main. When each man has finished, he immediately leaves on the double to a point of cover at least 75 yards away. The assistant squad leader sends forward additional pairs of men so not more than four men are exposed at one time.

(d) The assistant squad leader, who carries the two detonating assemblies, approaches with the last two men. He locates the ends of the detonating-cord main and connects the detonating assemblies.

(e) As connections are made, the squad leader moves down the line of obstacles checking each charge to see that it is properly placed and that all connections are properly made. When the squad leader has completed checking each charge, he joins the assistant squad leader and pulls the two fuse lighters. Both men then leave on the double to a point of cover at least 75 yards away.

(f) After the explosion, the squad leader runs forward to the gap, checking to see that all obstacles have been properly demolished and that the gap is satisfactory. Although the explosion clears a passage for tanks, it may be necessary to improve the gap for other vehicles by additional charges or hand labor.

21.03. Individual Steel and Log Obstacles

a. INDIVIDUAL STEEL OBSTACLES AND LOG POSTS. In general, methods of breaching concrete obstacles are also effective against steel or wood obstacles such as rails, tetrahedrons, hedgehogs, and posts. Plastic ex-

plosive is the recommended explosive since it can be easily wrapped or molded around steel or wood forms, insuring good contact. Quantities of explosives are computed from standard demolition formulas. However, this may be difficult with odd-shaped obstacles. Examples of charges for typical obstacles are shown in figure 21.03. For obstacles of different sizes than those shown, quantities should be increased or decreased accordingly. Generally, the charge should be placed at a joint where the obstacle is weakest. When obstacles are driven into the ground, the charge should be placed on the surface.

b. LOG CRIBS. (1) A log crib is demolished by 30 to 40 pounds of explosive placed in a hole in the center of the earth fill and two-thirds the depth of the crib. Similar charges are placed on 8-foot centers for the full length of the crib. All charges must be thoroughly tamped.

(2) A log crib can also be demolished by an external charge similar to that described in paragraph 21.04b(2).

21.04. Walls

a. CONCRETE WALLS NOT BACKFILLED. (1) *Quantity of explosives.* The following rule has been successfully applied for breaching gaps in well-reinforced, good-quality concrete walls: on walls up to 6 feet high and 6 feet thick, use 160 pounds of explosive per foot of thickness; on walls more than 6 feet high and 6 feet thick add 80 pounds of explosive for each additional foot of height or thickness. Thus, for a wall 8 feet thick and 10 feet high, the charge is $(6 \times 160) + (4 \times 80) + (2 \times 80)$, a total of 1,440 pounds.

(2) *Position of charge.* The explosive is elevated about 2 feet above the ground by stacking it on a 2- by 8-inch board 10 feet long placed on supports. Two empty explosives boxes about 6 feet apart may be used. This places the charge more nearly at the center of the concrete mass and prevents blowing a large crater in the ground in front of the wall.

(3) *Charge pattern.* For quantities of explosive up to 1,000 pounds, the charge should be placed in the form of a horizontal bar ((1), fig. 21.04a). The bar charge should be 10 feet long to assure a 12-foot gap and not over 8 inches thick to get the most out of each pound of explosive. For charges over 1,000 pounds, the additional explosive is added in three stacks placed at the center and at each end of the bar charge ((2), fig. 21.04a).

(4) *Wall joints.* When there are vertical joints in a reinforced-concrete wall, the charge should be placed at the joint. The blast breaks the joint and tends to throw the two ends of the wall outward and to the rear. If the charge cannot be placed where it covers a joint, the center of the charge should be at least 15 feet from the nearest joint. If the charge is closer, the joint tends to break and the mass of unshattered concrete between the joint and the gap is pulled towards the center by uncut reinforcing steel, thus blocking the gap.

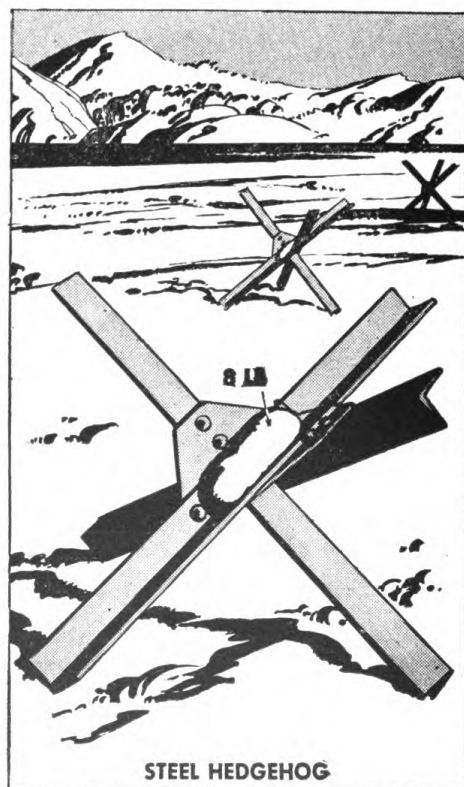
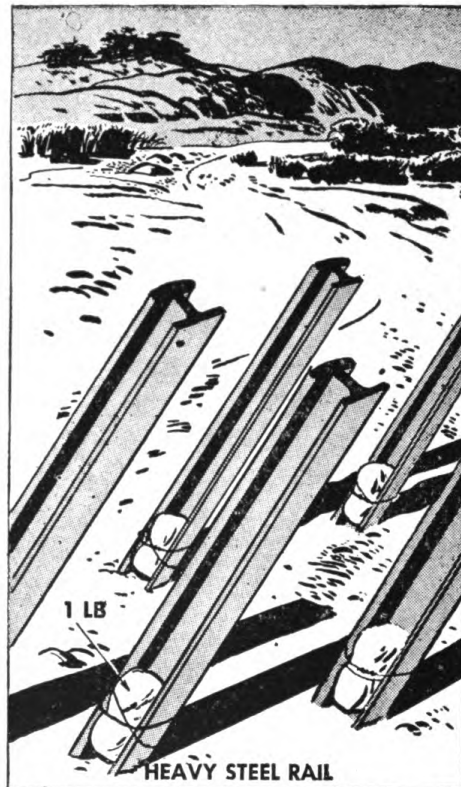
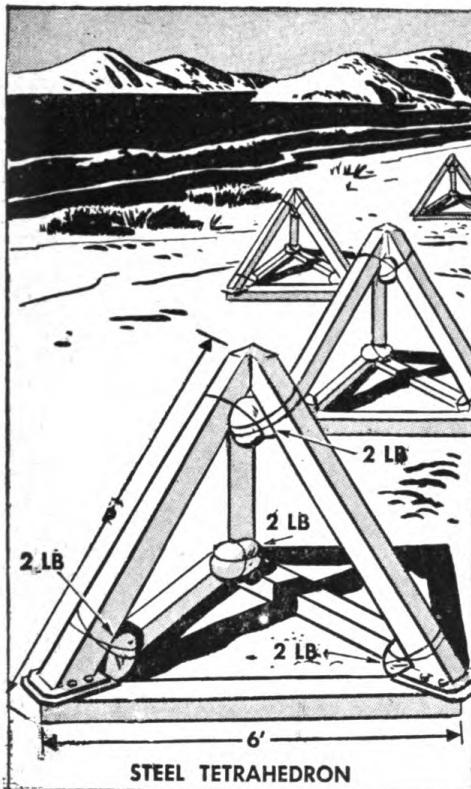


Figure 21.03. Size and placement of charges used against common steel and wooden obstacles.

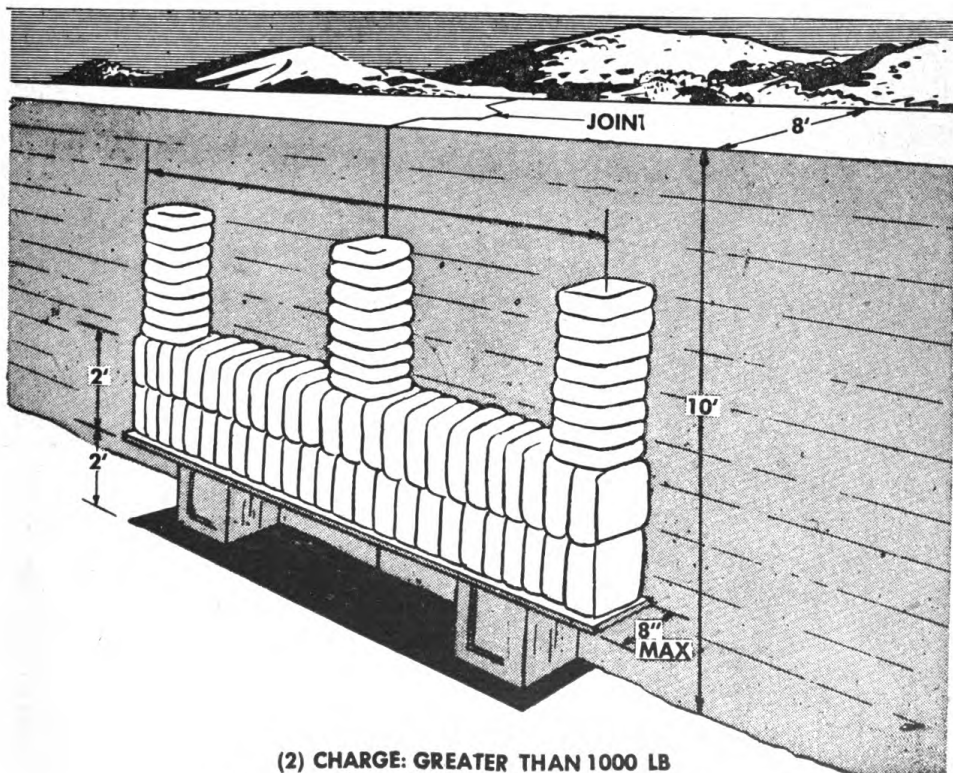
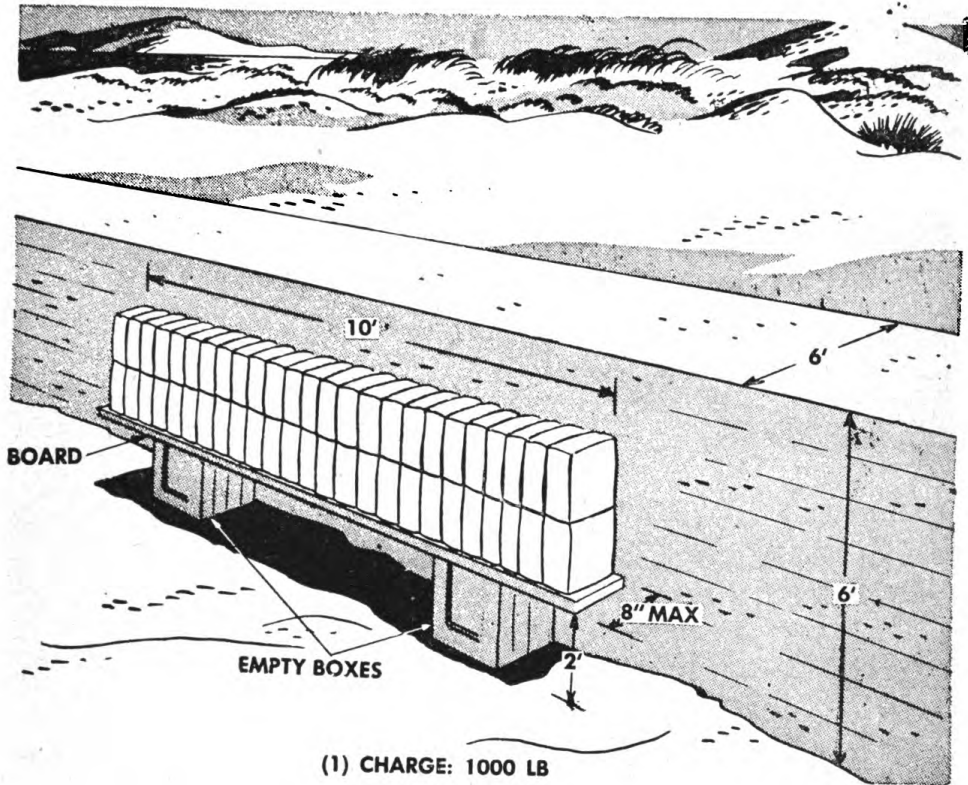


Figure 21.04a. Breaching concrete walls.

b. BACKFILLED WALLS. (1) Backfilled walls require more explosive than those not backfilled, because the backfill has to be blown aside and the slope decreased so it can be negotiated by the required vehicles. When walls are over 7 feet high, it is difficult for assault troops to place and fire an untamped charge which can produce a gap suitable for tanks. For example, a single untamped charge cannot be expected to blow a satisfactory breach in a reinforced-concrete wall 6 feet thick and 10 feet high backfilled with solid material, with a concrete road on top of the backfill. For backfilled concrete walls of smaller dimensions, explosive quantities required depend on characteristics of the wall. A general rule is to increase by 20 percent the charges specified for walls not backfilled. On some walls, a second shot may be required or dozers or hand labor used to widen the gap or decrease the slope of the backfill.

(2) Common types of backfilled walls encountered in the Pacific are about 6 feet high and are made with palm logs, log stumps, or coral. A 500-pound charge 10 feet long placed and fired on top of the wall 2 feet from the face blows a gap suitable for passage of tanks. (See fig. 21.04b.) When there is enough time, the charge should be tamped or dug in about 2 feet.

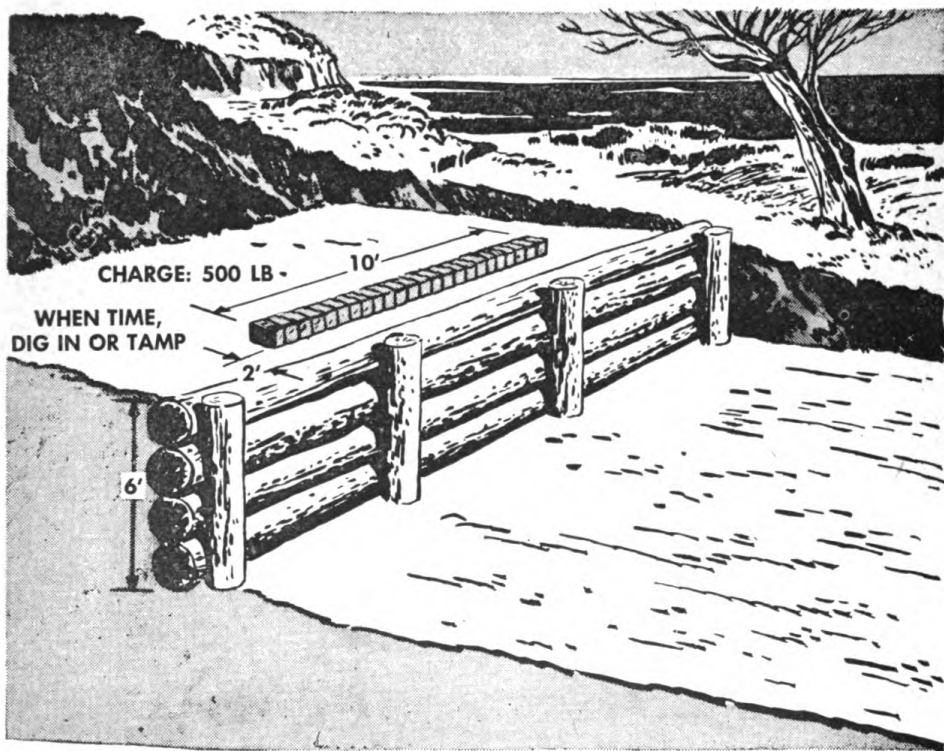


Figure 21.04b. Breaching backfilled log wall.

c. SHAPED CHARGES. Shaped charges can be used to produce holes in walls for placing internal charges. The size of the hole depends on the

quality of the concrete: in good concrete, M3 shaped charges make holes 5 feet deep, 4 inches in diameter at the surface, and 2 inches at the bottom. On walls up to 8 feet high, three shaped charges are placed 4 feet apart halfway up the wall. (See fig. 21.04c.) The resulting holes are cooled by a water-filled hand-operated fire extinguisher and are filled with plastic explosive or prepared TNT charges. Charges are primed and fired simultaneously. Walls more than 8 feet high require two rows of shaped charges placed 4 feet apart.

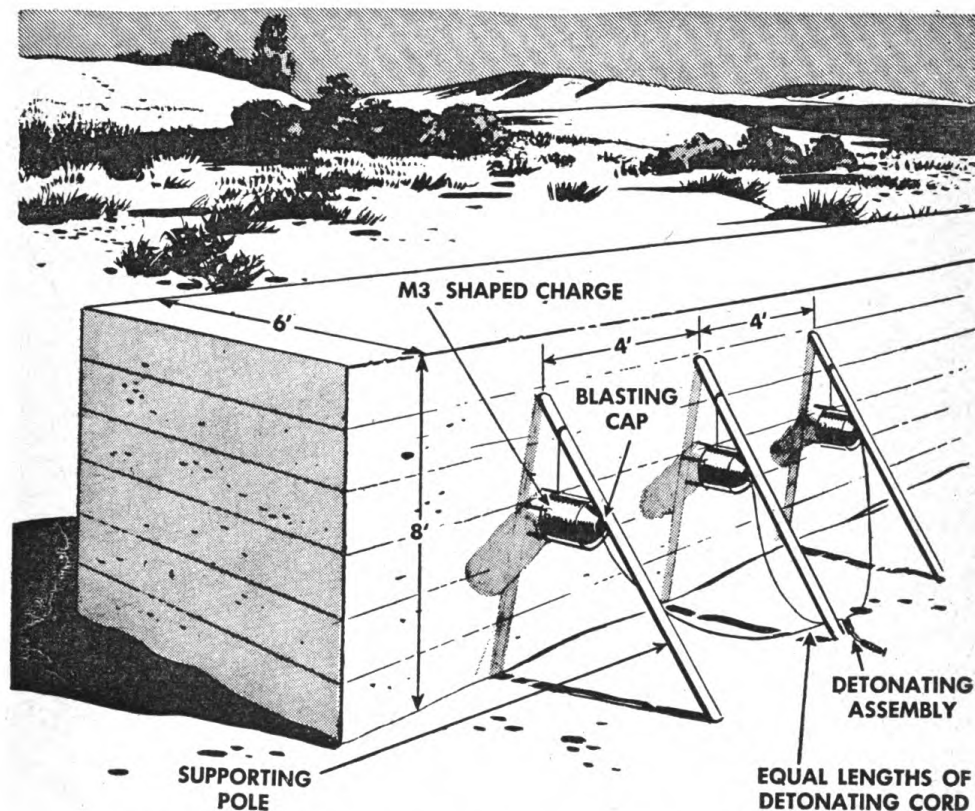


Figure 21.04c. Use of shaped charges to make boreholes for internal charges.

d. TANK OR ARTILLERY FIRE. Point-blank armor-piercing tank or artillery fire quickly produces boreholes for loading with plastic explosive or prepared TNT charges.

21.05. Antitank Ditches

The charge described above (par. 21.04b(2)) for backfilled log walls can be used for antitank ditches up to 8 feet deep by placing the charge further from the edge of the ditch when there is little or no revetment.

Section II. BANGALORE TORPEDO

22.01. Description

a. STANDARD BANGALORE TORPEDO. The standard bangalore torpedo (fig. 22.01) consists of 5-foot watertight sections joined together in any desired length. Each section weighs 13 pounds, of which 9½ pounds are explosive. The tube is filled with 80/20 amatol, with about 4 inches of TNT at each end. Sections have cap wells at each end so they can be joined in any order. One connecting sleeve for making rigid joints is issued with each section. A nose sleeve on the front end makes it easier to push the torpedo through entanglements. The torpedo is detonated by issue electric or nonelectric caps or by detonating cord. Small-arms fire may detonate a bangalore torpedo, particularly if one of the ends containing TNT is hit.

b. IMPROVISED BANGALORE. An improvised bangalore can be prepared from lengths of pipe filled with 2 pounds of explosive per foot. The pipe should be at least 24-gauge (0.025-inch) sheet metal with a 2-inch internal diameter. Explosive must be well packed in the pipe and successive pipe lengths must be closely connected.

22.02. Methods of Firing

When used for clearing obstacles, bangalore torpedoes are generally primed after they are assembled and in place ready to be fired. For bangalore torpedoes not provided with tape over the threaded cap well, a whittled wooden plug may be pushed into the cap well to prevent clogging with sand or other foreign material. The tape or plug is removed when the blasting cap is to be inserted. The following are methods of firing bangalore torpedoes in assault work:

a. METHOD 1. Screw a 15-second delay detonator into the cap well. It is compact and performs the functions of fuse lighter, time fuse, and blasting cap.

b. METHOD 2. When the 15-second delay detonator is not available or does not provide the desired delay, place a priming adapter and crimp a blasting cap on the end of a detonating assembly (par. 21.01e) or time fuse. To hold the blasting cap in place, insert it into the cap well and screw the adapter into the threaded recess. If a priming adapter is not available, insert the blasting cap into the cap well and wedge the detonating cord or time fuse in place with a small piece of wood.

c. METHOD 3. Tie the detonating cord on the end of a detonating assembly tightly around the end of the bangalore torpedo, using a four-loop clove hitch (clove hitch with two extra turns). The detonating cord must be within 4 inches of the end of the torpedo.

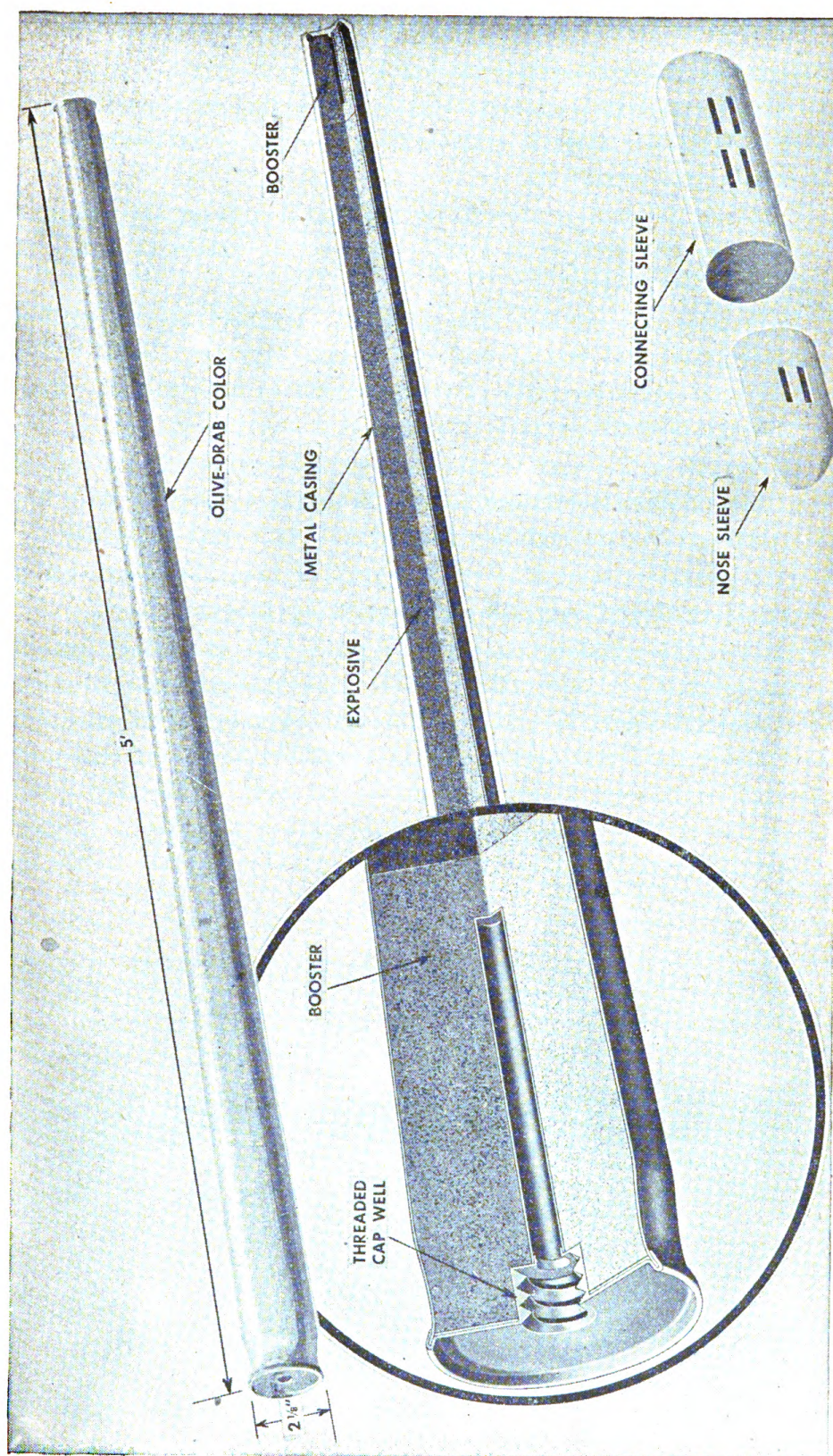


Figure 22.01. Bangalore torpedo.

22.03. Use Against Barbed Wire

a. PROCEDURE. The torpedo is used as follows:

(1) Carry torpedo in convenient lengths, depending on size of breaching party. Approach obstacle with caution, watching for antitank and antipersonnel mines around it.

(2) To avoid detonating torpedo by pushing it into an antipersonnel mine, attach dummy section to nose. Use branch, length of wood, or empty pipe for this purpose.

(3) Push nose section into entanglement. Connect second section, push forward, and add rest of sections in same manner. Total length must be at least equal to depth of entanglement to be breached. Push torpedo through obstacle, preferably alongside center picket.

(4) If obstacle is too deep to push one torpedo completely through it, breach in two or more operations. Clear as deeply as possible with first torpedo; then advance through gap formed and place next bangalore.

(5) Fire bangalore only after all members of breaching party are at least 30 yards away and well protected with sufficient cover.

b. EFFECT. The standard bangalore clears a 10- to 15-foot lane in wire entanglements. (See fig. 22.03.) It explodes antipersonnel mines and some antitank mines in a path slightly narrower than the lane cut in the wire. Antitank mines may be left in a sensitive state, and care must be exercised in clearing mines adjacent to the path. The chief disadvantage is that secrecy is lost when the bangalore is detonated. Detonation should therefore be delayed until the last possible moment before the assault.

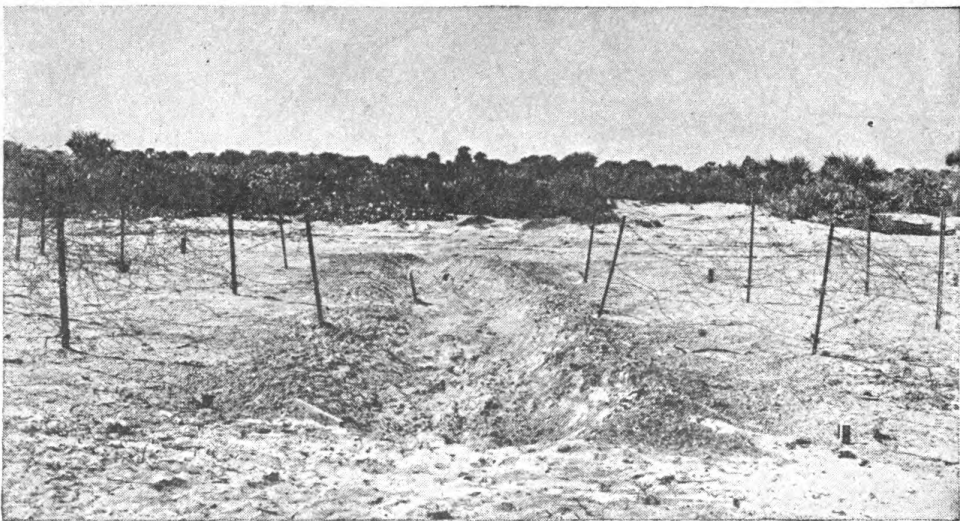


Figure 22.03. Path cleared through barbed wire by bangalore torpedo.

22.04. Use Against Steel Hedgehog

To demolish a steel hedgehog with a bangalore torpedo, secure the bangalore along one leg of the hedgehog. A bangalore torpedo or other elongated charge is not as satisfactory as a concentrated charge at the joint.

22.05. Use Against Log Hurdle

A log hurdle of the size ordinarily encountered can be destroyed by two bangalore torpedoes placed side by side in a crevice between logs in the obstacle.

Section III. DEMOLITION SNAKES**23.01. General**

Paragraph 23.02 to 23.10 describes component parts, assembly, movement, detonation, and effect of snake, demolition, M3, used in breaching obstacles other than mine fields. Paragraph 23.11 notes the essential differences between the M2, M2A1, and M3 demolition snakes. Tactical use of demolition snakes and their effect on mine fields are described in FM 5-31.

23.02. Description of M3 Demolition Snake Parts

a. GENERAL. The snake, demolition, M3 consists of two parallel linear explosive charges encased between corrugated aluminum plates, bolted together to form a rigid assembly which can be towed or pushed by a light or medium tank. (See figs. 23.02*a* and 23.02*b*.) It is flexible in vertical plane to permit it to pass over rough ground and rigid enough in horizontal plane so it will maintain a relatively true course when being pushed. The assembled M3 demolition snake is 14 inches wide, 5 inches high, and 400 feet long. It weighs approximately 9,000 pounds, including 4,500 pounds of explosives. A list of parts issued with each snake is given in table I.

Table I. Accessories, tools, and component parts for construction of 400-foot M3 demolition snake.

Item	Quantity
<i>Snake parts:</i>	
Corrugated aluminum body plate.....	200
11/16-inch bolt, 3 inches long.....	210
Special washer.....	420
11/16-inch square nut.....	210
Nose.....	1
Nose adapter and towing hook.....	1
Nose retainer.....	1
Tamping bag.....	40
Pushing hook.....	1
Fuze shield.....	2
Tail ramp.....	1
<i>Explosives:</i>	
Explosive cartridge for M3 demolition snake.....	128
M1 bullet impact fuze.....	2
<i>Tank accessories:</i>	
Pulley support post with pulley.....	5
Rope guide ring with pulley.....	2
Rope guide ring.....	1
3/8-inch sash cord (feet).....	15
1/8-inch aircraft cable (feet).....	33
Cable clamp.....	1
Periscope fitting (for medium tank).....	1
Direct-vision port fitting (for light tank).....	1
Crank.....	1
Towing-yoke assembly.....	1
5/8-inch pushing chain, 5 1/2 feet long.....	1
<i>Tools:</i>	
Structural wrench.....	6
Socket-wrench assembly.....	2

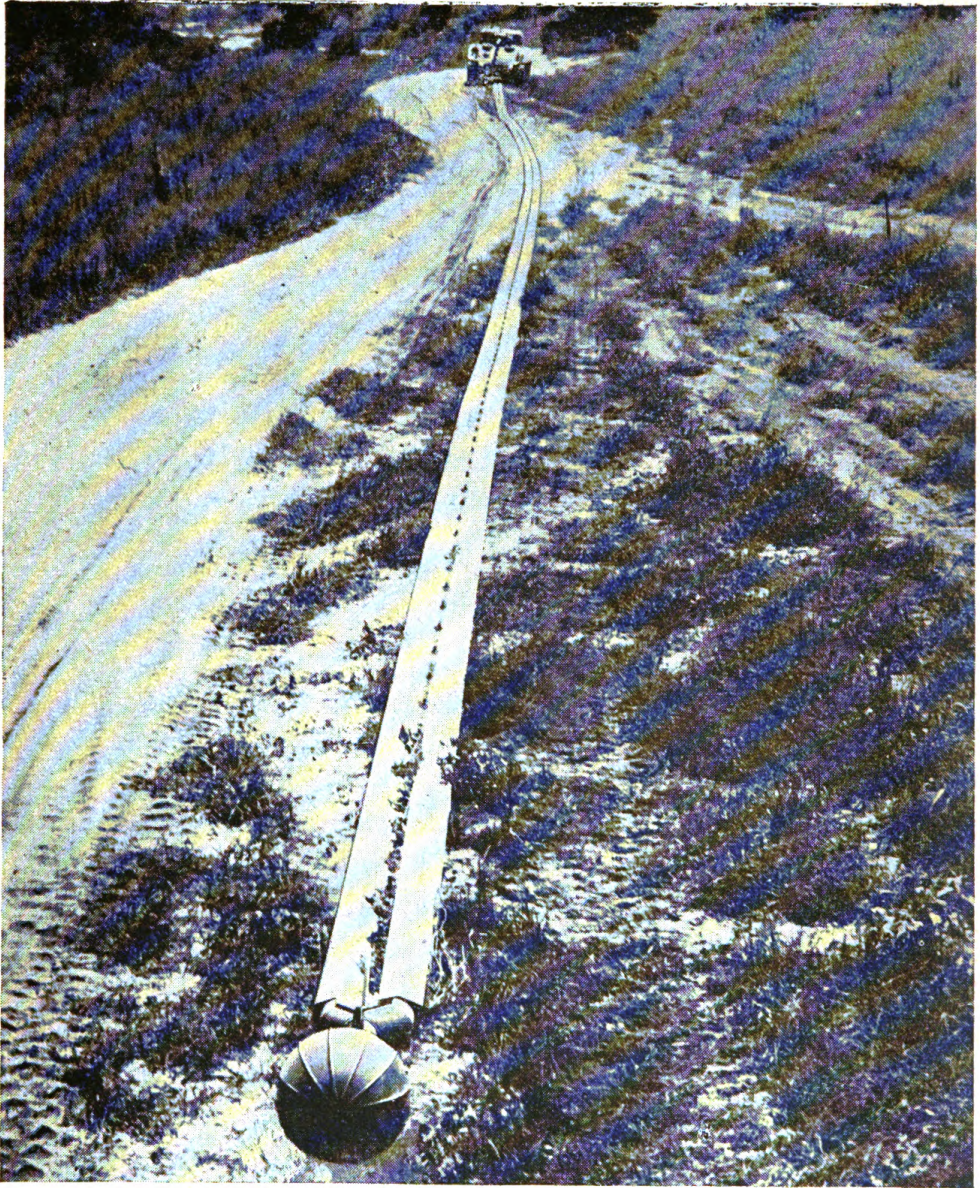


Figure 23.02a. Medium tank pushing demolition snake.

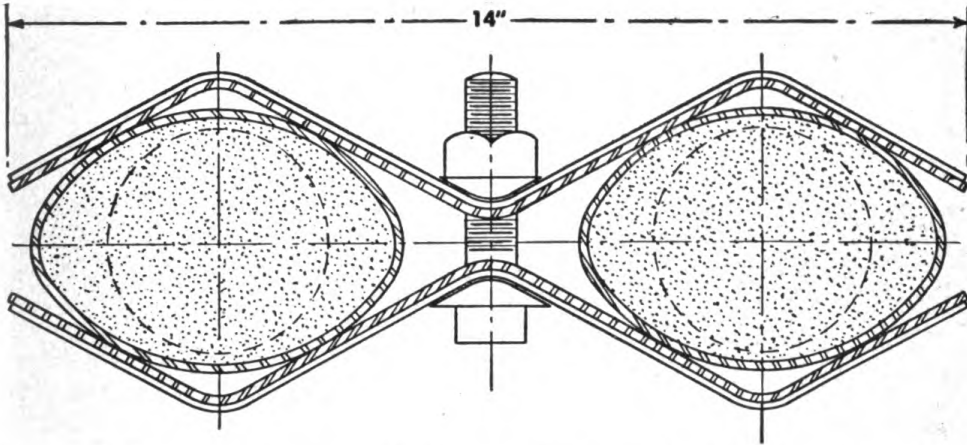


Figure 23.02b. Cross-section of M3 demolition snake loaded with explosive cartridges.

b. BODY PLATES. The corrugated aluminum plates (fig. 23.02c) form the body of the demolition snake. Top and bottom plates are identical. Each plate is 9 feet long and 14 inches wide, about $\frac{1}{8}$ of an inch thick, and weighs 16 pounds. Five holes are spaced 2 feet apart along the center of the plate, starting 6 inches from either end. The plates are painted olive-drab with a patch of white paint around each bolt hole for ease in locating holes in night assembly.

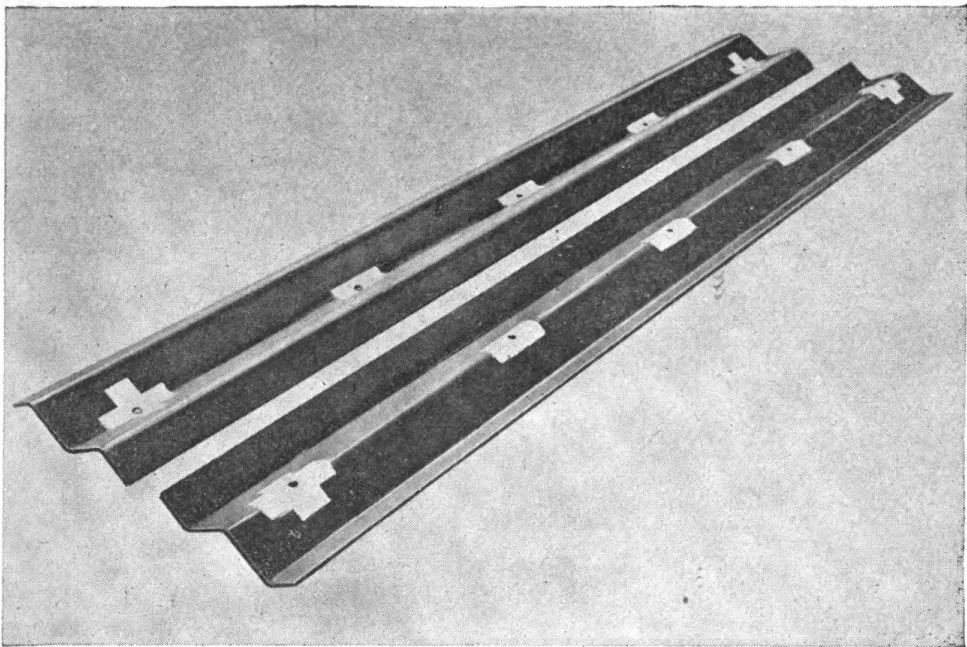


Figure 23.02c. Corrugated aluminum plates, M3 demolition snake.

c. BOLTS, WASHERS, AND NUTS (fig. 23.02d). Three-inch by $\frac{11}{16}$ -inch steel bolts and washers and nuts are used to fasten the corrugated

plates together. The washers are specially shaped to assure a uniform bearing surface. Nuts and bolt heads are 1 inch square.

d. NOSE ADAPTER AND TOWING HOOK (figs. 23.02e and 23.04b). The nose adapter connects the demolition snake to the nose. It is fitted be-

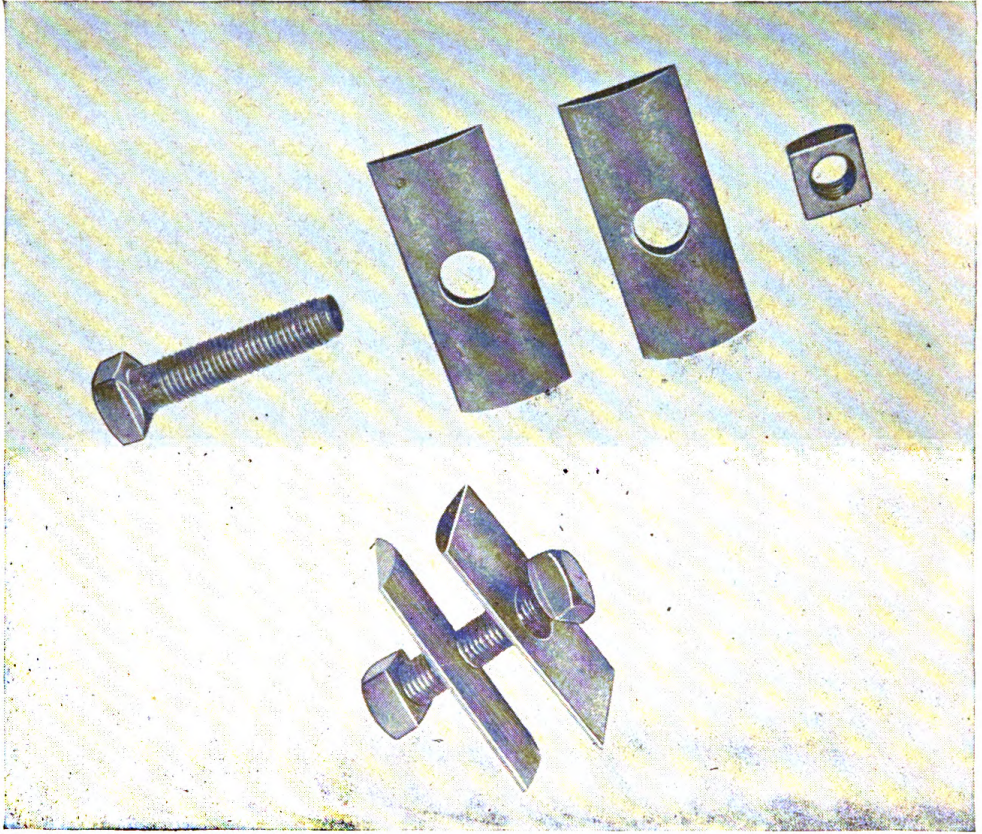


Figure 23.02d. Bolts, washers, and nuts for M3 demolition snake.

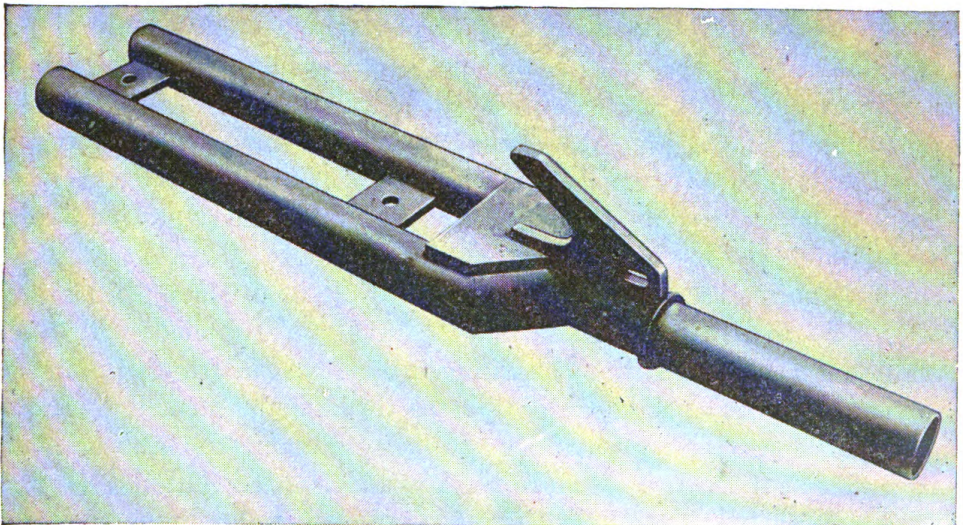


Figure 23.02e. Nose adapter and towing hook, M3 demolition snake.

tween the body plates at the forward end of the snake and is secured by two bolts which fasten the plates together. The towing hook is an integral part of the adapter, being welded to its upper side as shown. A bumper ring around the adapter just forward of the towing hook prevents the nose sliding too far back over the adapter.

e. NOSE AND NOSE RETAINER (figs. 23.02f and 23.04b). The hollow pear-shaped aluminum nose fits over the nose adapter. It is secured to the adapter with the nose retainer. It is free to swivel slightly in any direction and aids in guiding the forward end of the demolition snake over or around obstructions, such as trees or boulders.

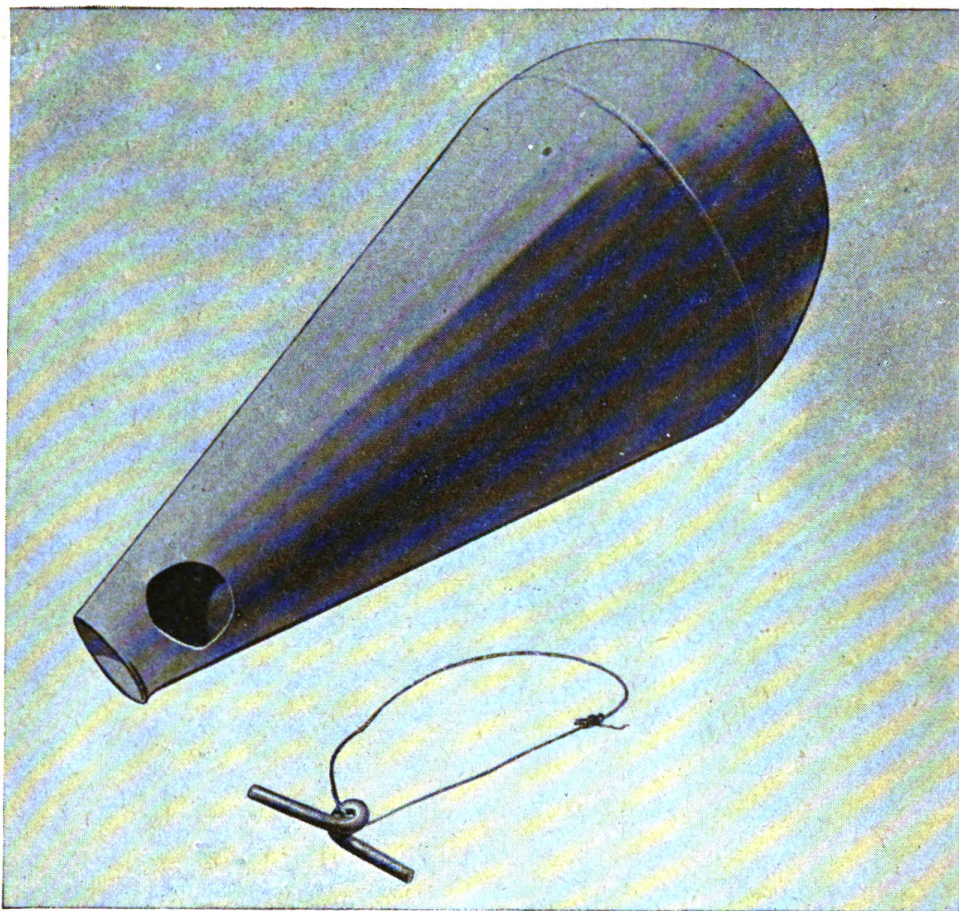
f. PUSHING HOOK (fig. 23.02g). The pushing-hook assembly consists of a hook welded to a steel bar, which has four bolt holes for attachment to the demolition snake. A flat steel plate welded to the top of the hook bears against the belly of the tank during pushing operations. The assembly is bolted to the snake's rearmost plate, starting with the second bolt hole from the rear end.

g. TAIL RAMP (fig. 23.02h). The tail ramp is a small hinged steel skid which fastens to the rearmost bolt of the demolition snake. The hinged bar extends beyond the snake and drags on the ground to prevent the pushing chain from fouling on the end of the snake when engaging the pushing hook.

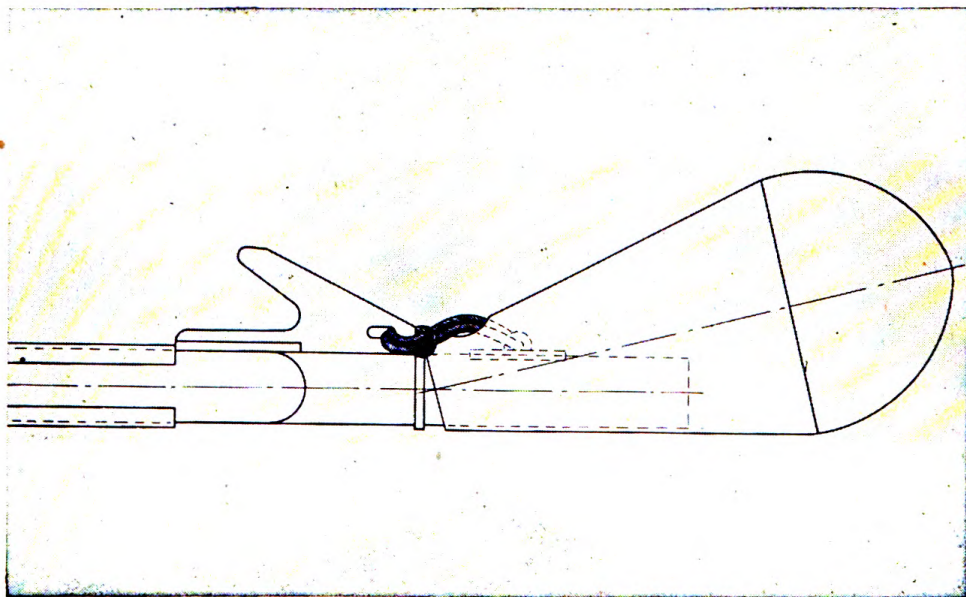
h. EXPLOSIVE CHARGES. (1) *Explosive cartridges* (fig. 23.02i). Elliptical explosive cartridges are issued with the M3 demolition snake. They are $5\frac{3}{8}$ inches wide, $3\frac{3}{4}$ inches high, and 5 feet long, and weigh 40 pounds, including approximately 35 pounds of explosive. The bulk of the explosive is 80/20 amatol, with a 6-inch booster charge of crystal-line TNT in each end. One end contains a cap well to receive a blasting cap, when the cartridges are used for general demolition work. One hundred twenty-eight cartridges are loaded in 320 feet of a 400-foot snake, giving an explosive weight of 14 pounds per loaded foot.

(2) *Bangalore torpedoes*. Bangalore torpedoes may be used as an alternate explosive when demolition snake cartridges are not available or when stubs of exploded demolition snakes are salvaged to build new snakes. A bundle of four bangalores (fig. 23.02j) is loaded in each corrugation of the snake. The eight bangalores give an explosive weight of 14.4 pounds per loaded foot.

i. M1 BULLET IMPACT FUZE AND FUZE SHIELD (figs. 23.02k and 23.02l). (1) *Fuze*. Two bullet impact fuzes are supplied with each demolition snake. The fuze has an impact plate held in front of a striker pin by three springs. A shear pin passes through the striker pin. Bullets from the machine gun of the pushing tank hit the impact plate, forcing it against the striker-pin head. The shear wire is cut and the fuze detonates, exploding the snake. The impact plate is luminous so it can be seen at night. The fuze is made safe for transportation by a safety



①



②

Figure 23.02f. Nose and nose retainer, M3 demolition snake.

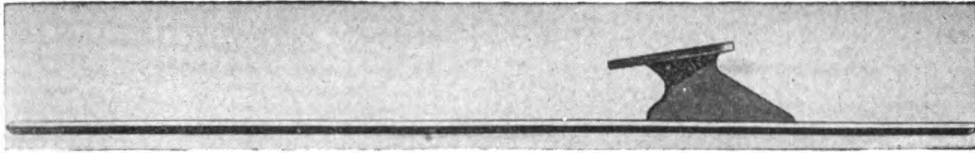


Figure 23.02g. Pushing hook, M3 demolition snake.

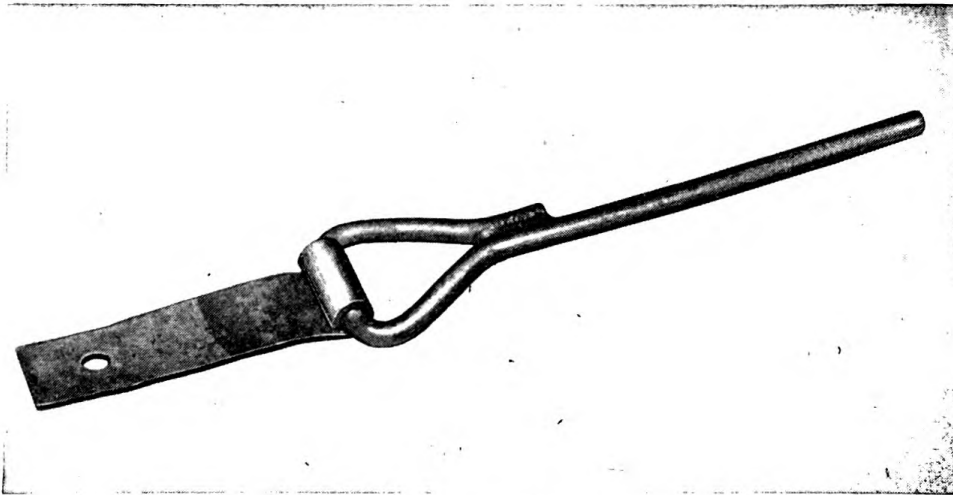


Figure 23.02h. Tail ramp, M3 demolition snake.

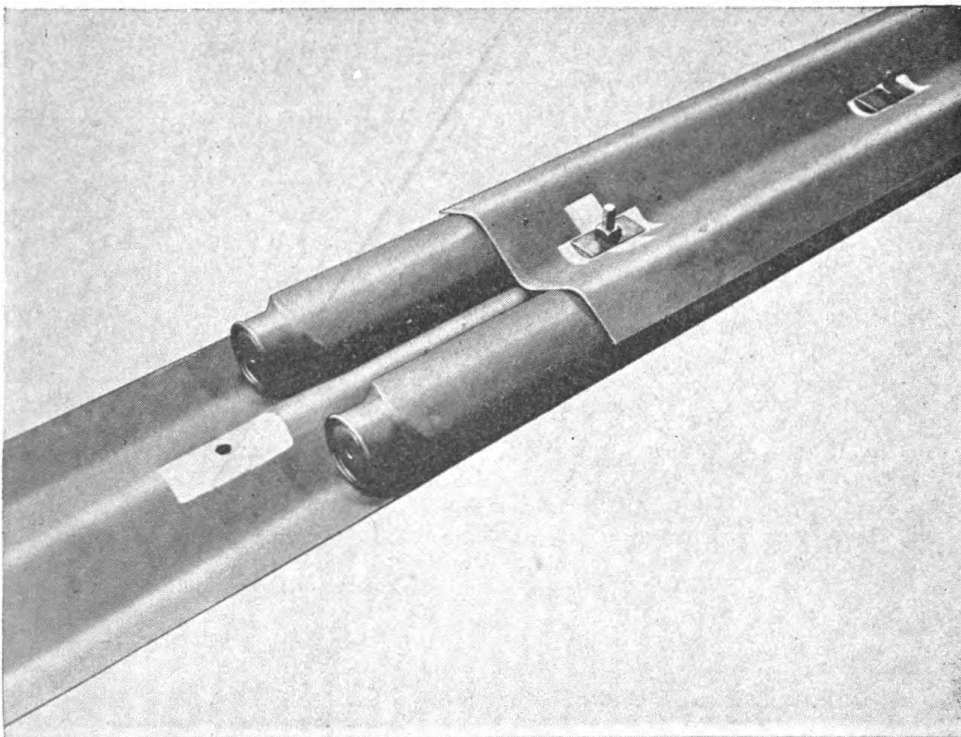


Figure 23.02i. M3 demolition snake loaded with explosive cartridges.

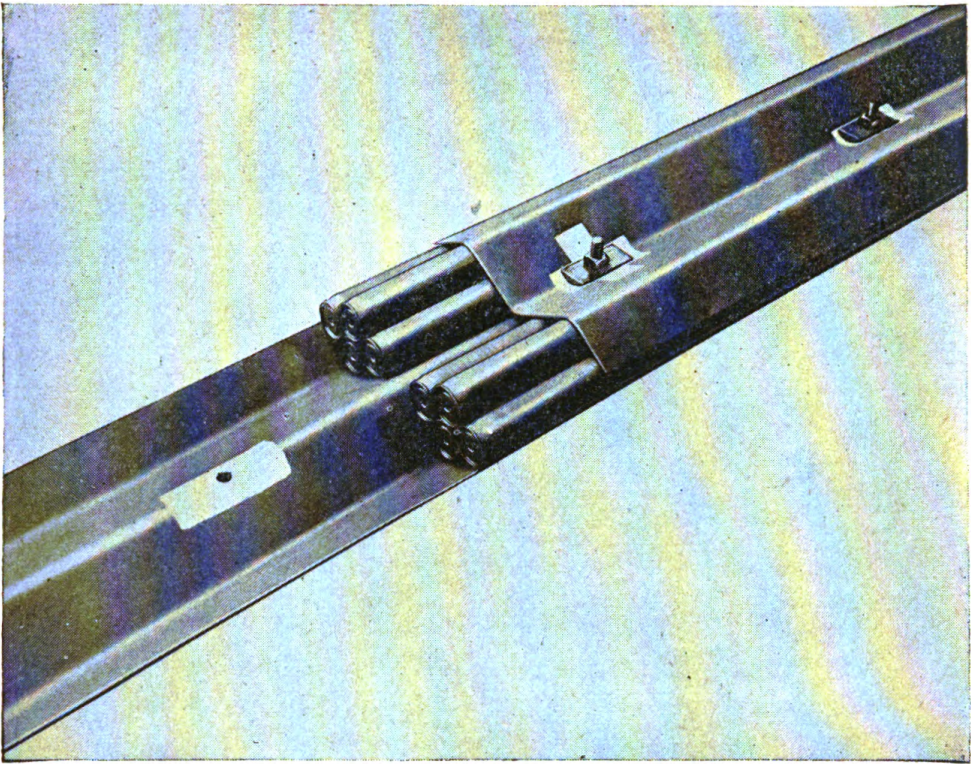


Figure 23.02j. M3 demolition snake loaded with bangalore torpedoes.

fork inserted between the head of the striker pin and the body of the striker-pin housing. The safety fork is removed just before the fuze is installed in the shield.

(2) *Fuze shield.* The fuze shield serves as a bracket for mounting the fuze and protects it from premature detonation or damage by frontal small-arms fire. A cotter pin chained to the shield is inserted in a hole in the shield to hold the fuze in position. In bolting the shield to the demolition snake, it is necessary that the TNT ends of the cartridges be centered directly below the body of the fuze, otherwise the amatol portion of the cartridge may not detonate.

j. **TAMPING BAGS** (figs. 23.02m). Forty light cloth or paper bags, 4 inches in diameter and 24 inches long, are furnished with each demolition snake for use as tamping bags to prevent the charge from shifting. They are filled with dirt to within 3 inches of the top, the end is folded over, and the bags are placed in both ends of the snake. When available, 75-mm ammunition containers filled with dirt are excellent for tamping.

23.03. Tank Accessories (figs. 23.03a)

a. **PUSHING AND TOWING ASSEMBLIES.** (1) *Pushing chain.* A 5½-foot length of 5⁄8-inch chain, fastened to the tank's front towing clevises (figs. 23.05b), is used to push the demolition snake. A length of sash



Figure 23.02k. M1 bullet impact fuze.

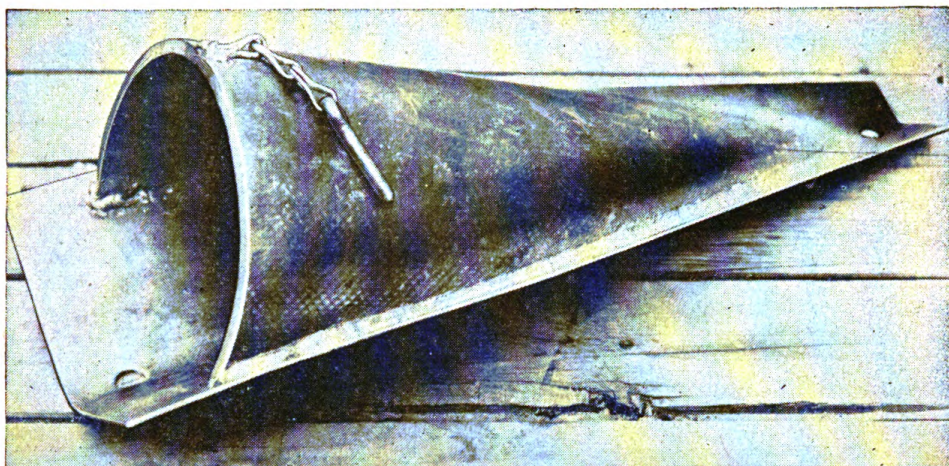


Figure 23.02l. Fuze shield, M3 demolition snake.

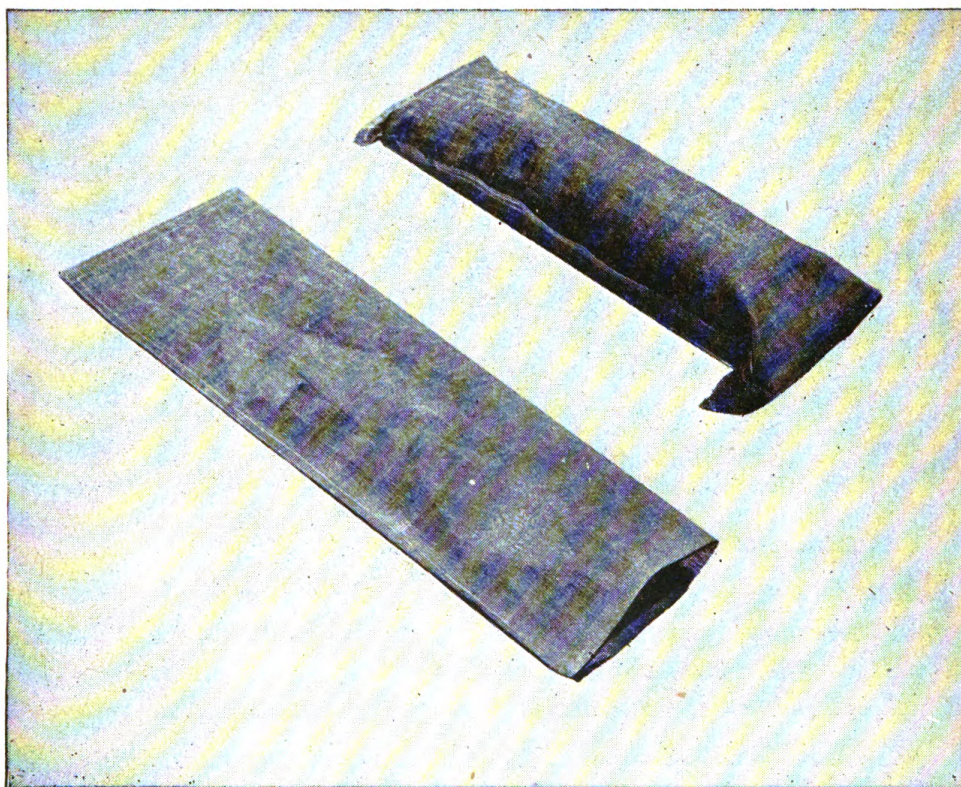


Figure 23.02m. Tamping bags, M3 demolition snake.

cord tied to the chain leads into the tank for raising and lowering the chain.

(2) *Towing yoke assembly.* The towing yoke assembly is used to tow the demolition snake behind a tank. It consists of two 1-inch square bars pinned to the rear towing lugs of the tank, a semicircular yoke pinned to the outer ends of the bars which catches the snake towing hook, a lifting bail bolted to the yoke for lifting the assembly, and a coil spring shackled to the lifting bail to act as a shock absorber while maneuvering the tank with the yoke disengaged from the snake.

(3) *Pulleys and cable.* A length of $\frac{1}{8}$ -inch cable clamped to the coil spring runs along the top right side of the tank through a series of pulleys welded to the tank hull and enters the tank at the bow gunner's seat. It is used to raise and lower the towing yoke assembly.

(4) *Periscope and port fittings.* The periscope fitting is placed in the bow gunner's forward periscope slot in the medium tank. The sash cord tied to the pushing chain and the $\frac{1}{8}$ -inch cable from the towing yoke assembly enter the tank through holes in the fitting. The direct-vision port fitting is used on the M5 light tank instead of the periscope fitting. It fits in the bow gunner's direct-vision port and operates the same as the periscope fitting.

b. **WRENCHES.** (fig. 23.03b). Two double-socket wrenches and six open-end wrenches are supplied for assembling the demolition snake. The tapered ends are used as driftpins to align the plates during assembly.

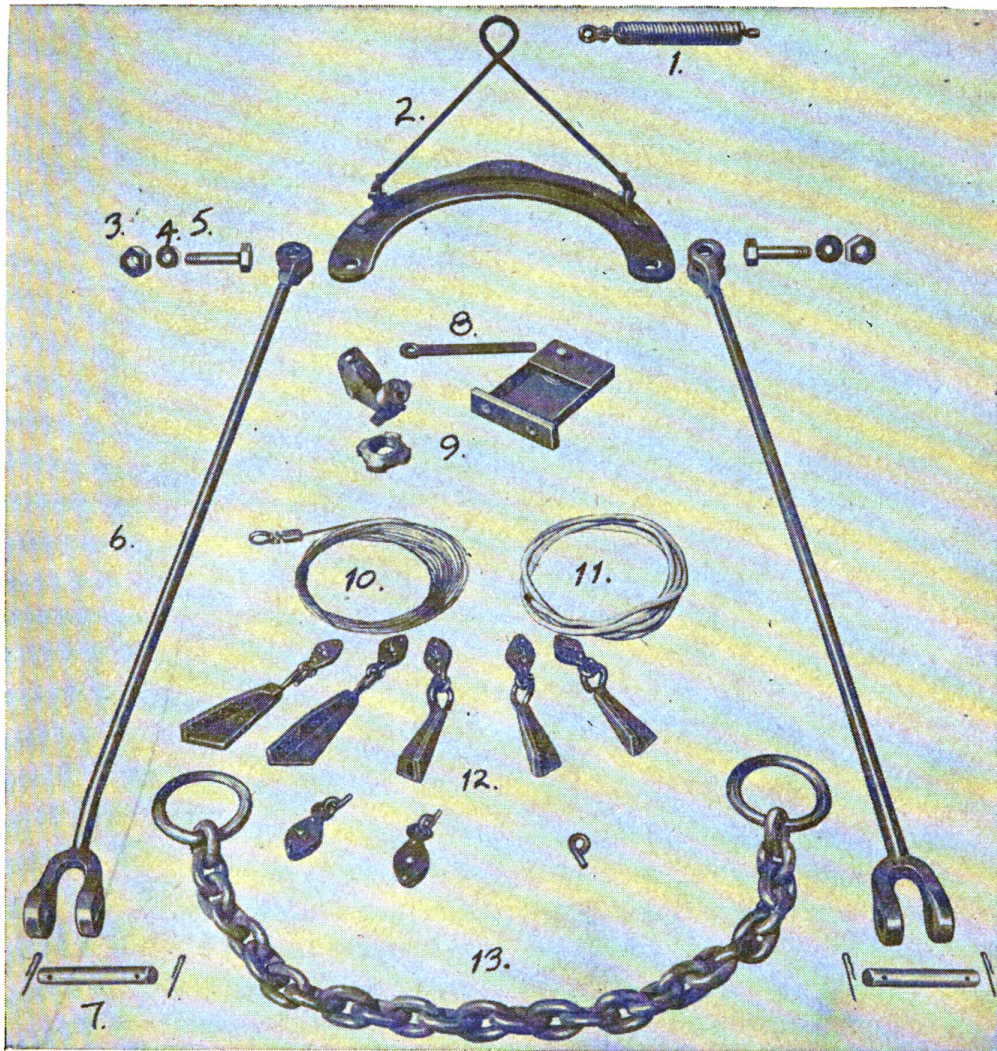
c. **ADDITIONAL EQUIPMENT.** The following equipment is not issued with the demolition snake, but is required for its construction:

- 2 heavy wrecking bars to assist in moving or lifting sections of snake.
- 4 mallets and wedges to open explosive packing boxes.
- 1 shovel to fill tamping bags.
- 1 2½-ton or larger truck with winch, half-track with winch, or tank to tow snake backward as it is assembled.
- 30 driftpins, $\frac{1}{2}$, $\frac{5}{8}$, or $\frac{3}{4}$ inch in diameter, to align bolt holes during assembly.

23.04. Assembly of Demolition Snake

a. **PERSONNEL.** (1) *Size of crew.* (a) The size of the crew may vary considerably, depending on working conditions and time allotted for the job. A crew of one platoon, consisting of 1 officer, 7 NCO's, and 32 enlisted men, with the following organization is suggested:

- 1 officerPlanning and general supervision.
- 1 NCO (s sgt).....Supervises assembly.
- 1 NCO (sgt)Controls assembly of bottom plates and placing explosives.



- 1 Coilspring.
- 2 Yoke.
- 3 Nut.
- 4 Washer.
- 5 Bolt.
- 6 Bar.
- 7 Pins.

- 8 Wrench.
- 9 Periscope fitting.
- 10 Cable.
- 11 Sash cord.
- 12 Pulleys.
- 13 Pushing chain.

Figure 23.03a. Tank accessories, M3 demolition snake.

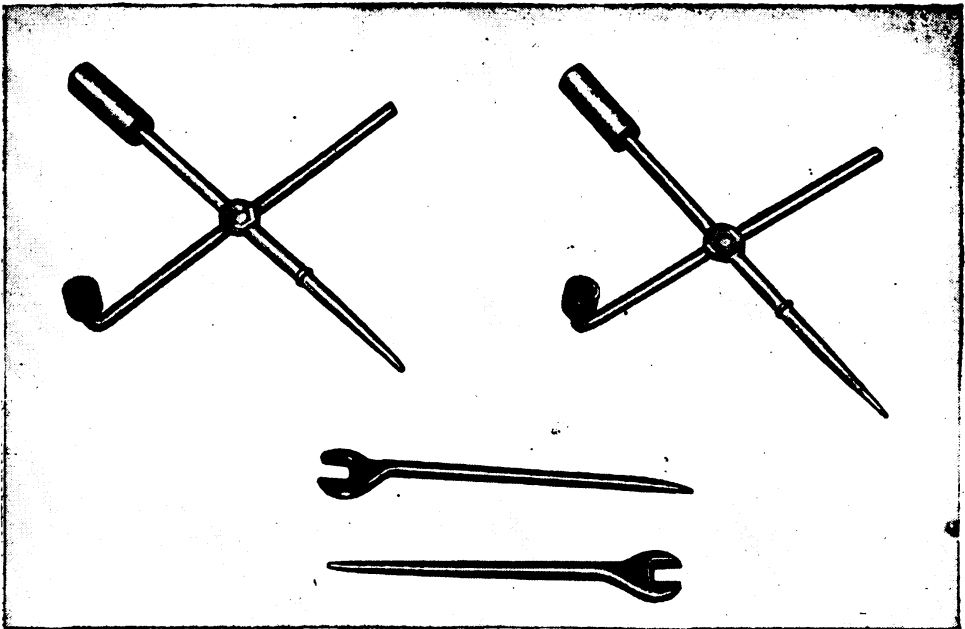


Figure 23.03b. Assembly wrenches, M3 demolition snake.

- 1 NCO (sgt) Controls assembly of top plates and special fittings.
- 1 NCO (cpl) Checks completed assembly and tightness of bolts.
- 2 EM Carry and place bottom plates.
- 2 EM Align bolt holes with driftpins as plates are assembled.
- 2 EM Carry and place explosives and tamping bags.
- 4 EM Carry and place top plates and special attachments.
- 1 EM Distributes bolts, washers, and nuts along snake.
- 2 EM Place bolts, washers, and nuts, and tighten by hand.
- 2 EM Finish tightening bolts with wrenches.
- 2 EM Open and stack explosives.
- 3 NCO's and 15 EM..... Do general-utility work, such as preparing site, unloading, carrying, and stacking materials, and assisting or relieving other details.

(b) This organization is large enough to give flexibility. The work must be carefully planned and closely supervised for maximum efficiency and speed. A demolition snake can be assembled in 2 hours or less by a well-trained crew.

(2) *Orientation and training.* Personnel must be thoroughly trained to assemble the demolition snake efficiently and to eliminate undue fear of handling large explosive charges. Personnel should realize that only an almost-direct hit with artillery will detonate the snake. High-explosive 105-mm projectiles must land within 1 yard of the snake to detonate it. Small-arms fire striking the crystalline TNT ends of the snake cartridge may detonate it. The snake should be assembled several times during both day and night until the crew is entirely familiar with the parts and their assembly before attempting to use the snake in any military operations. A practice detonation of a snake is desirable for the benefit of both assembly and operating personnel.

b. *SELECTION OF SITE.* A level assembly site is desirable, but any fairly smooth area may be used. The surrounding terrain must permit towing the demolition snake backward as increments are added, and towing it forward when completed. The site should be as near as possible to the point of anticipated detonation, preferably within 1 mile and in defile from enemy fire and observation.

c. *PREPARATION.* (1) Before starting assembly, the approximate alignment of the demolition snake is determined and the site prepared. Either of the following methods can be used:

(a) Place expedient supports, such as short logs at least 5 inches in diameter, at 5-foot intervals along the line on which the demolition snake is to be assembled. The logs elevate the snake, so bolts can be easily inserted from the bottom. Drive stakes at the ends of the logs to keep them in position when towing the snake.

(b) Dig a trench 3 feet wide by 6 inches deep and 45 feet long to permit insertion of bolts from the bottom. Place eight demolition snake plates with edges down across it at 5-foot intervals to support the snake during assembly. Five-foot lengths of 3-inch pipe or 4-inch logs may be used instead of the snake plates. Pile spoil from the trench on the ends of the supporting plates to prevent their displacement when towing the snake.

(2) The top of the demolition snake is divided into sections A, B, and C and the bottom into sections D, E, and F. Figure 23.04a gives in tabular form the number of plates in each section, and indicates the lapping of plates within sections.

(3) Assembly is facilitated if bottom plates are placed on one side of the assembly line and top plates on the other. Plates should be staked in piles containing the proper number of plates for each section. (See fig. 23.04a.) Explosives are placed on the same side as the bottom plates.

Since plates within each section have the same overlap, assembly crews can tell when a change in lapping is required by watching the stacks.

d. GENERAL ASSEMBLY PROCEDURE. The general assembly procedure is as follows:

(1) Place bottom plates with center ridge up and align bolt holes. Place cartridges and tamping bags in the corrugations. Place cover plates with center ridge down and align bolt holes. Bolt top and bottom plates together. Tow completed portion to rear and retighten all bolts.

(2) To facilitate feathering of plates, assemble the demolition snake from rear to front. Build it in about 40-foot increments and tow it to the rear after each increment is added to minimize carrying of parts. Towing shakes parts into better alignment, permitting bolts to be retightened and increasing structural stability.

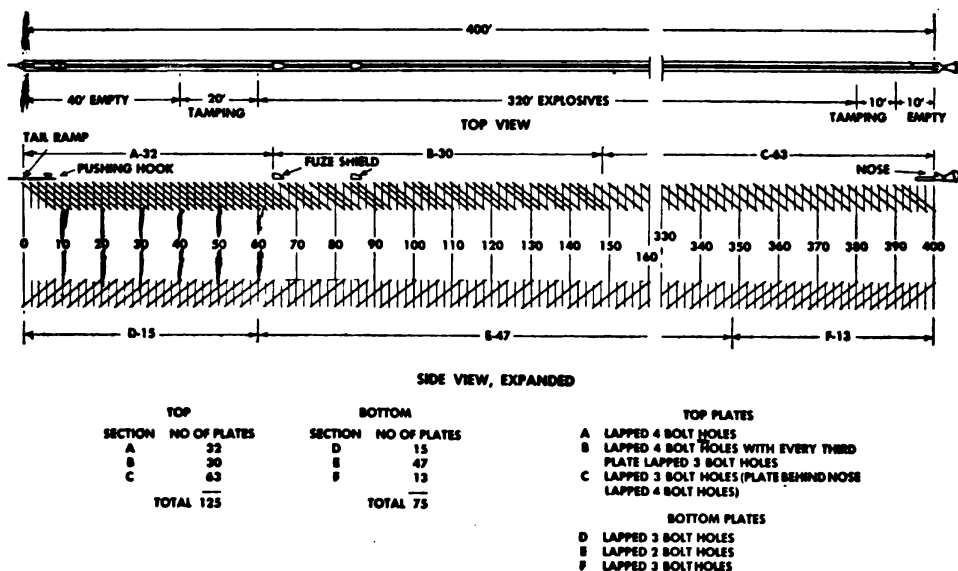


Figure 23.04a. Assembly diagram for M3 demolition snake.

e. DETAILED ASSEMBLY. (1) Rear 40 feet. (a) To assemble the rear 40 feet of demolition snake, underlap each successive belly plate (sec. D, fig. 23.04a) and then overlap each successive cover plate. (See sec. A, fig. 23.04a.) The bottom-plate carrying detail carries plates from the proper stack and places them with the correct lapping. After lapping is checked by the NCO in charge, aligners, working on the opposite side of the snake, align the bolt holes with driftpins or ends of assembly wrenches. Pins are left in place until they interfere with placing of top plates. This rearmost 40-foot section contains no explosives but, when time permits, is completely filled with tamping for additional stability.

(b) Aligners remove interfering driftpins from bolt holes. Top plates are placed from the proper stack with the correct overlap (fig.

23.04a) and pins are reinserted for realignment. When the plates are placed and properly aligned, the bolt carrier distributes one bolt, two washers, and one nut to each bolt hole along the demolition snake. Fasten tail ramp with rearmost bolt and hinge it forward to prevent its being damaged during assembly of the snake. Fasten pushing hook with the four bolts immediately ahead of the rear bolt. (See fig. 23.04b.) The bolting detail removes the driftpins from each bolt hole, thrusts the bolt (with washer) through the hole from the bottom, places the top washer, and hand-tightens the nut. Wrench handlers then finish tightening the nuts with wrenches.

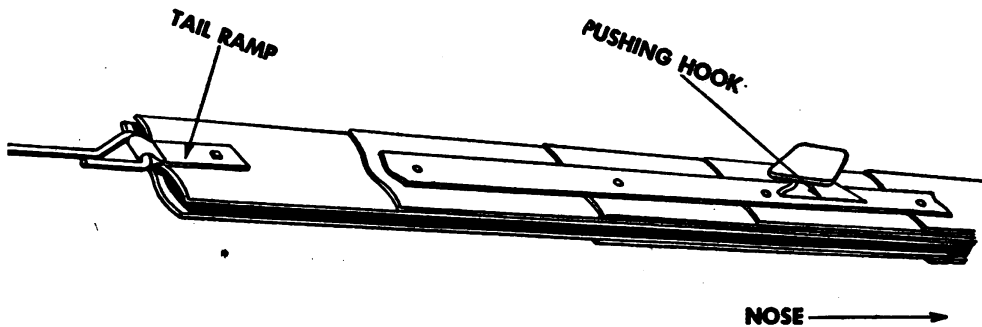


Figure 23.04b. Assembled tail of M3 demolition snake.

(2) *Central portion of demolition snake.* (a) After the first 40 feet are towed to the rear, place the next 40 feet of bottom plates. The lapping of plates changes from three bolt holes per plate in section D to two holes per plate in section E, 60 feet from the rear end of the demolition snake. Use all bottom plates from the first stack and then take plates from the next stack. At this stage, determine the locations of the fuze shields. (See fig. 23.04c.) The open end of the first fuze shield will be bolted to the snake at the thirty-third bolt from the rear end. The open end of the other shield will be bolted to the snake 10 bolt holes (20 feet) forward of the open end of the first shield. Place the first pair of cartridges or bangalore torpedoes with the forward ends 6 inches in front of the hole to which the open end of the shield will be fastened. This places the open end of the rear shield 64 feet from the tail of the snake and insures that 12 inches of TNT (in inches in each of the adjacent cartridges) is beneath the body of the fuze.

(b) Tightly pack earth-filled tamping bags for 20 feet in back of rearmost explosive charges without disturbing their position. The explosive detail places additional charges forward of the two already placed. The cartridges or bangalore torpedoes must fit tightly end-to-end, to prevent the crystalline TNT booster portion of the charge from shifting beneath the fuzes. This should be checked by the NCO in charge.

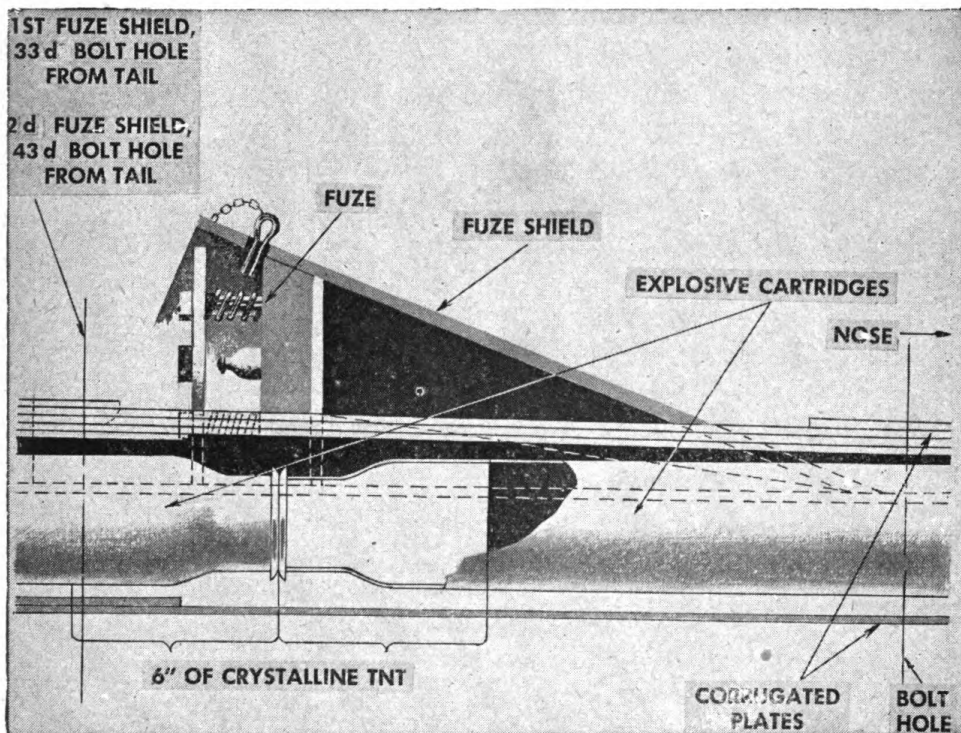


Figure 23.04c. Longitudinal section of M3 demolition snake at fuze.

(c) After the explosive cartridges are properly placed, assemble the cover plates, paying particular attention to the change in lapping between sections A and B. During the bolting of this portion, mount the fuze shields on the cover plates at the predetermined locations. Do not place the fuzes in the shields until the assembly is complete and the snake is ready for use. Assemble successive portions of the snake similarly. Note the change in lapping belly plates, 348 feet from the rear end.

(3) *Front portion of demolition snake.* (a) Assemble the front portion of the demolition snake in the same way. Lap one of the top plates in forward section C over four bolt holes instead of three, so the belly and cover plates terminate at the same point. This four-hole lap is made most easily with the last plate.

(b) Place explosive cartridges to within 20 feet of the front end of the snake and then add 10 feet of tamping bags to prevent them from moving.

(c) Fasten the nose adapter between the belly and cover plates at the forward end of the snake by the two foremost bolts. Slip the nose over the adapter until it is snug against the bumper ring. Pass one end of the nose-retainer wire-rope loop through the hole in the towing hook. Pass the retainer bar through the loop on the opposite side of the hook, through the hole in the nose, and position it inside the nose with the bar across the opening. (See figs. 23.02f and 23.04d.)

(d) Position the remaining cover plates and bolt them into place. When assembly is completed, it is checked by the junior NCO, all bolts are retightened, and the tail ramp is hinged to the rear.

(e) Arm the demolition snake by removing the safety forks and inserting the fuzes within the shields. The fuze must be seated well forward against the vertical stop plate inside the shield. Fasten it in place with the cotter key chained to the shield.

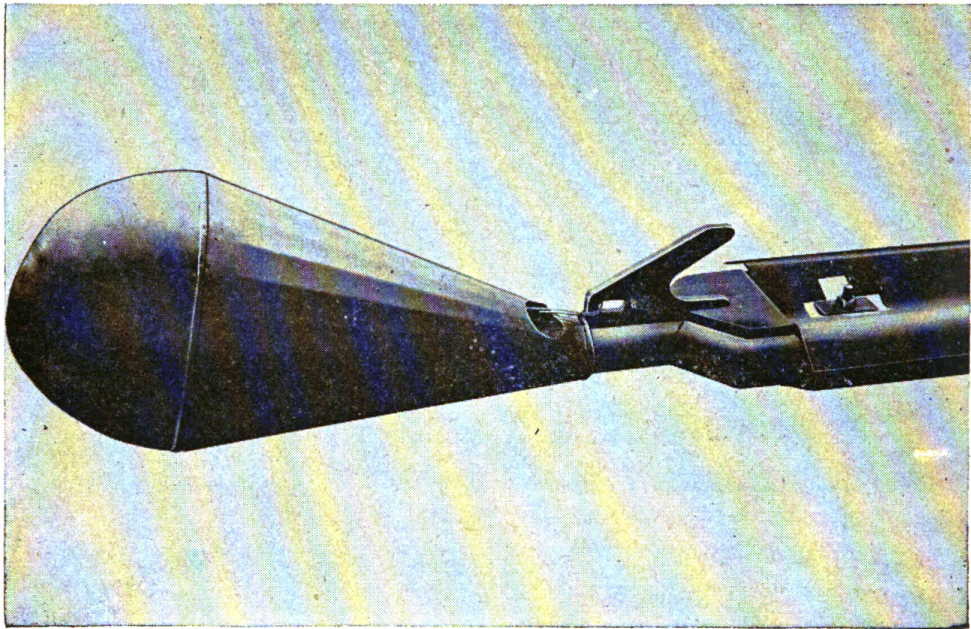


Figure 23.04d. Nose assembly, M3 demolition snake.

23.05. Assembly of Towing and Pushing Assemblies

a. TOWING ASSEMBLY. Bolt the towing rods and lifting bail (figs. 23.03a) to the towing yoke. Pin the front ends of the rods to the rear towing lugs of the tank and shackle the coil spring to the lifting bail. (See fig. 23.05a.)

b. PUSHING CHAIN. Fasten the pushing chain to the front clevises of the tank. (See fig. 23.05b.)

c. RIGGING FIXTURES (fig. 23.03a). (1) *Pulleys and mounting posts.* Five pulley support posts with pulleys, two rope guide rings with pulleys, and one rope guide ring are furnished with each demolition snake. They are used in lifting the towing yoke and pushing chain and are welded on the tank hull. Location of the pulleys depends on the tank model. Figure 23.05c shows location of the fittings welded on several typical tanks. Posts and guide rings must be welded so that tank gun clears them when the turret is traversed and the gun is at its lowest elevation.

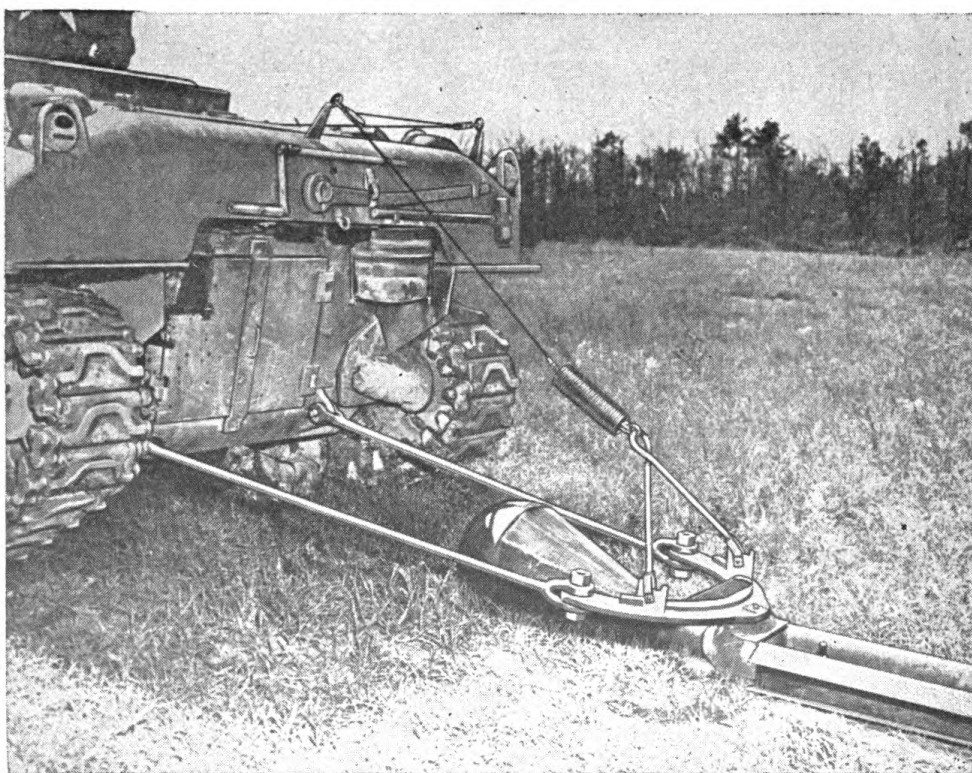
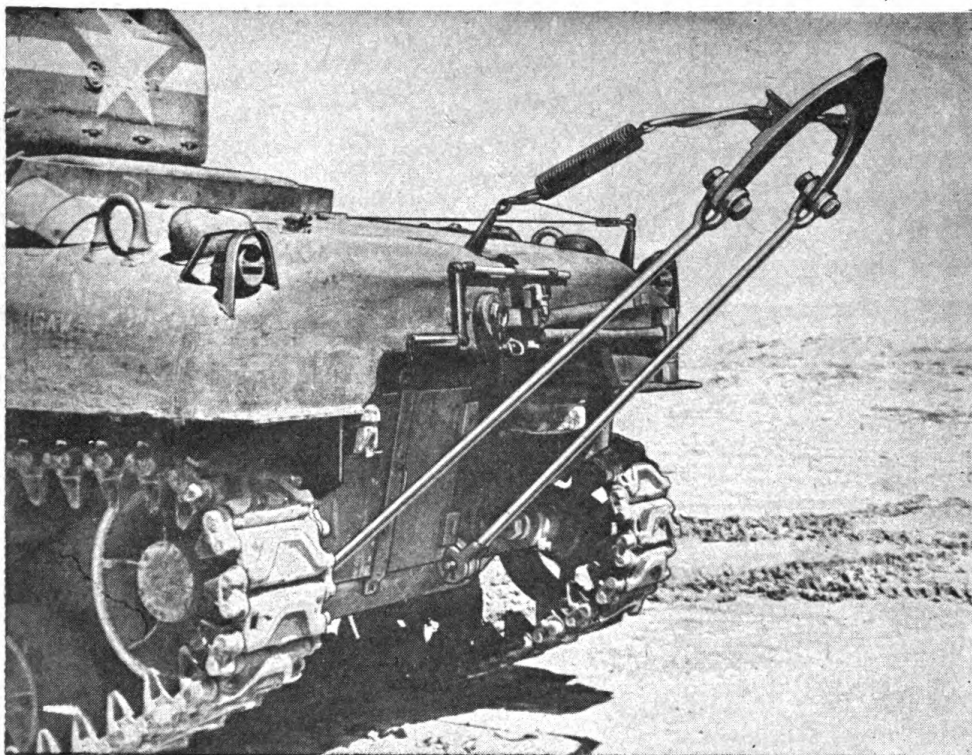


Figure 23.05a. Towing assembly, M3 demolition snake.

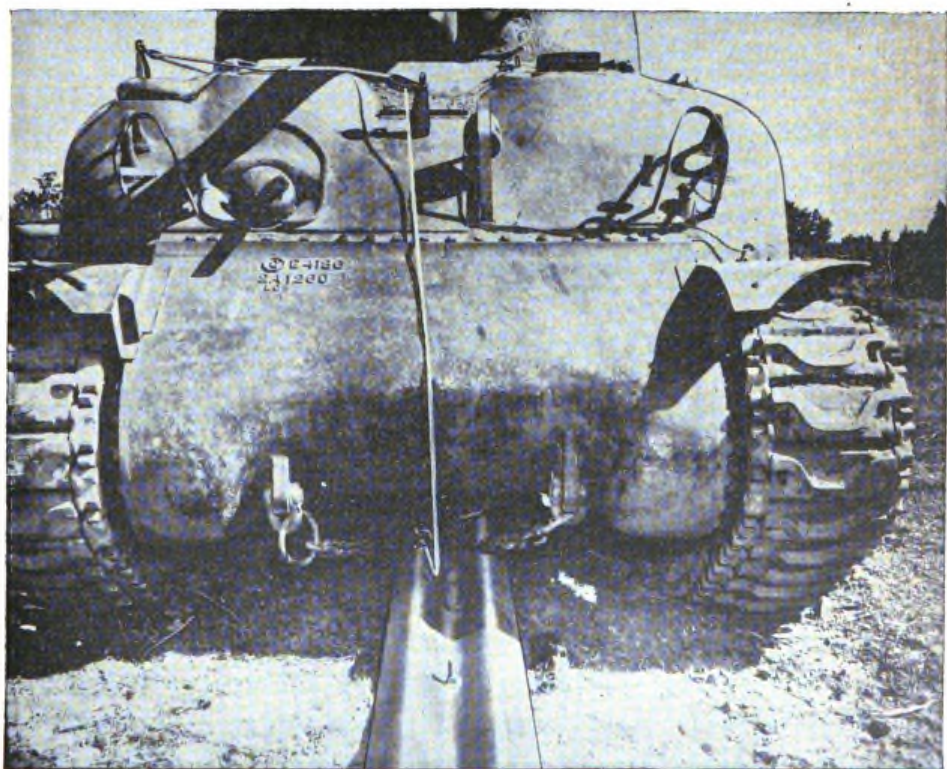


Figure 23.05b. Pushing assembly, M3 demolition snake.

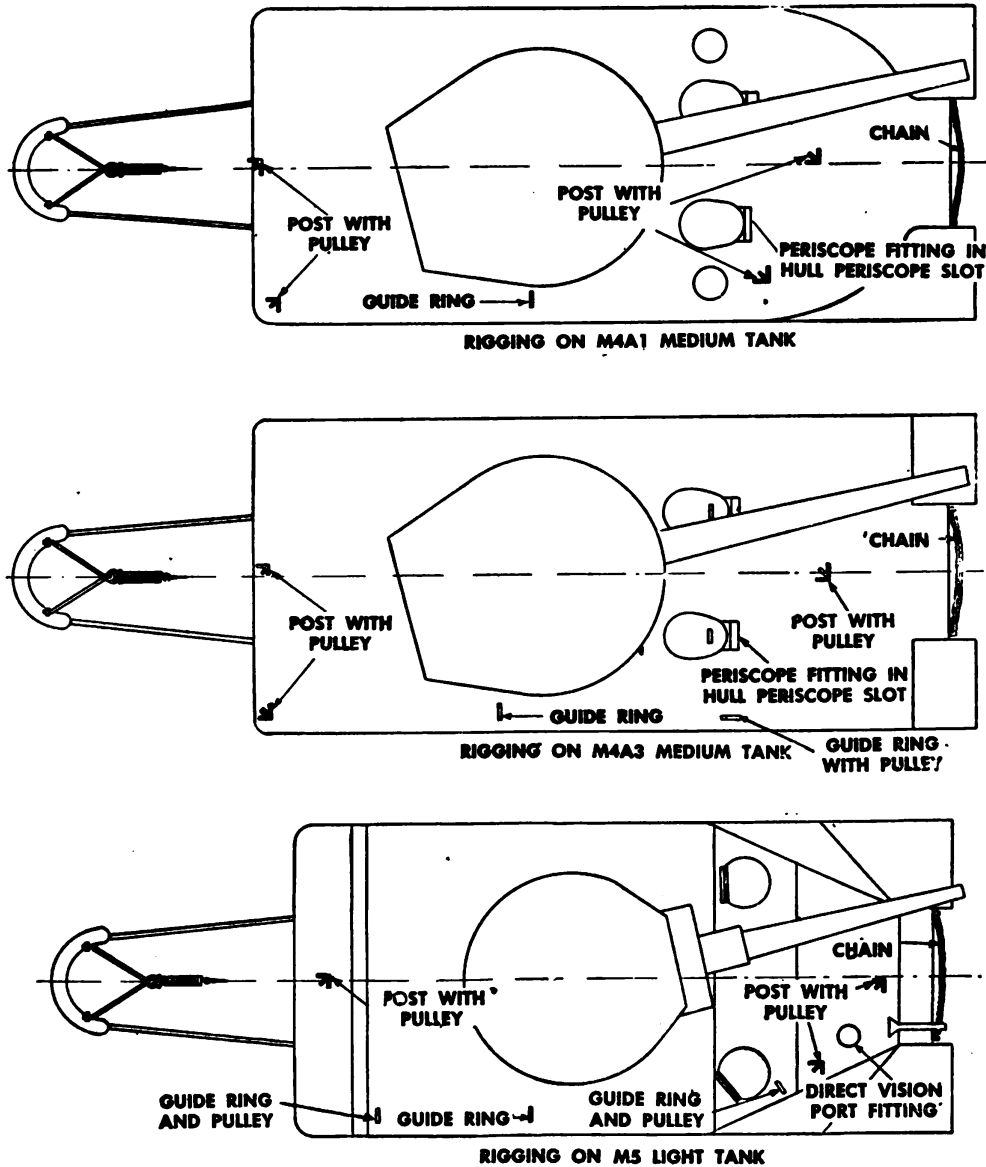


Figure 23.05c. Location of rigging fixtures on tank hulls.

(2) *Periscope fitting.* The periscope fitting, through which the towing yoke cable and the pushing-chain rope enter the tank, fits in the periscope slot on medium tanks. The bow gunner in most tanks of the M4 series has two periscopes; one in the hatch door and one in the hull just forward of the hatch door. The periscope fitting is inserted in the bow gunner's hull-periscope slot. On some early production models of M4 series tanks, the bow gunner has a periscope in the hatch cover and direct-vision slot in the hull. When these tanks are used, the periscope fitting is inserted in the periscope slot in the bow gunner's hatch cover. In this case, the bow gunner's view is obstructed and he cannot use his machine gun, and the coaxially-mounted machine gun

must be used to detonate the snake. As an alternate method, a cover plate for the radio-antenna hole on the right of the bow gunner may be improvised, and the direct-vision port fitting mounted on the plate.

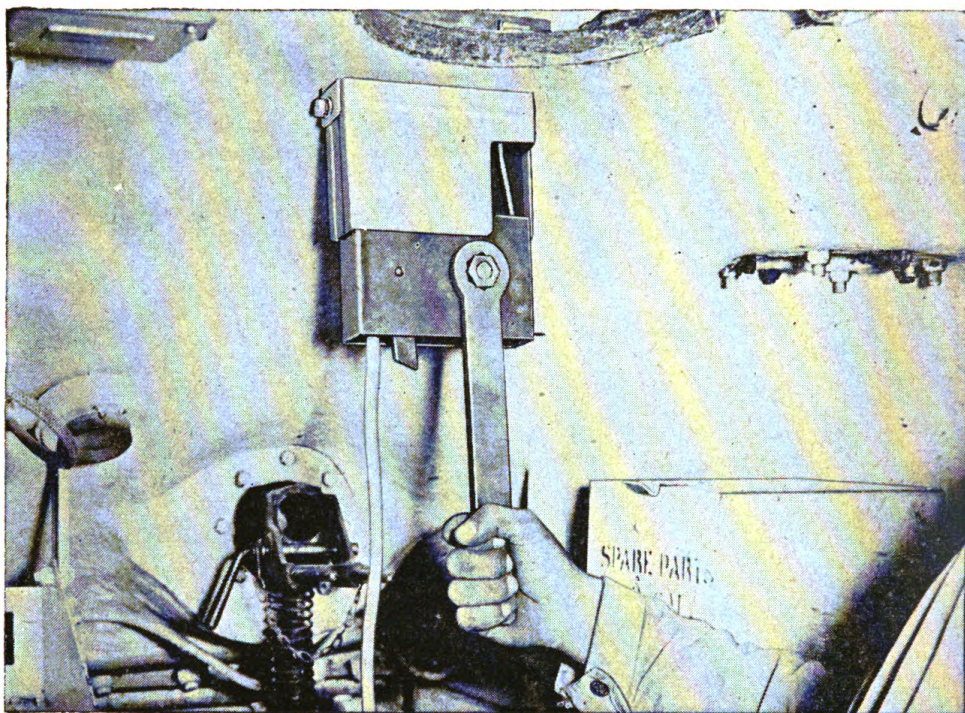


Figure 23.05d. Medium-tank bow gunner raising towing assembly using wrench issued with M3 demolition snake.

(3) *Direct-vision port fitting.* This fitting is used on M5 light tanks in place of the periscope fitting. The cover plate over the bow gunner's direct-vision port is removed and the fitting is inserted in the port and fastened in place.

(4) *Rigging.* Tie the sash cord securely to the pushing chain, thread it through the front pulley, and take it into the tank through the larger hole in the periscope or direct-vision port fitting. Fasten one end of the $\frac{1}{8}$ -inch cable to the coil spring on the lifting bail, using the special cable clamp. Then, thread the cable through the pulleys and into the tank through the smaller hole in the periscope or direct-vision port fitting. Wind the end of the cable on the reel in the fitting. The pushing chain is raised and lowered by hand with the cash cord. The towing yoke is raised by winding the reel on the periscope or direct-vision port fitting. A wrench is provided for winding the reel, but the yoke can be raised much faster using ratchet wrench with 1-inch socket in the tank tool kit. To drop the yoke, the ratchet bar on the reel is pushed to the right.

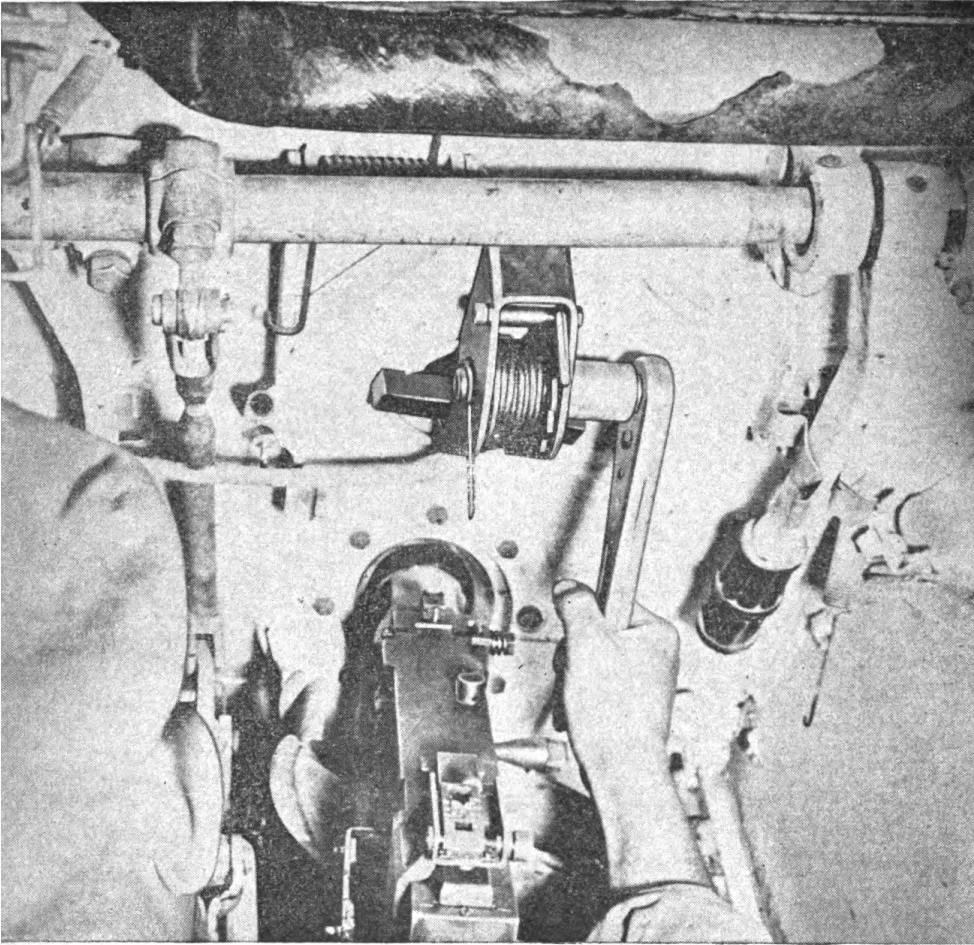


Figure 23.05e. Light-tank bow gunner raising towing assembly using ratchet wrench in tank tool kit.

23.06. Night Assembly

a. Night assembly procedure is the same as during the day, but requires more practice and normally requires two to three times as long as day assembly. Parts must be laid out where they are easily accessible and can be readily found. Close supervision is important to insure proper assembly. Driftpins and wrenches are less easily lost if painted white.

b. Even though the fuze faces are coated with luminous paint, they often cannot be seen from inside the tank at night. Therefore, when firing a demolition snake at night, a standard flashlight should be wired securely to the bolt nearest the fuze, with the beam directed on the fuze. (See fig. 23.06.) An alternate method is to place a piece of white paper under the flashlight lens to diffuse the beam and point the flashlight toward the bank.

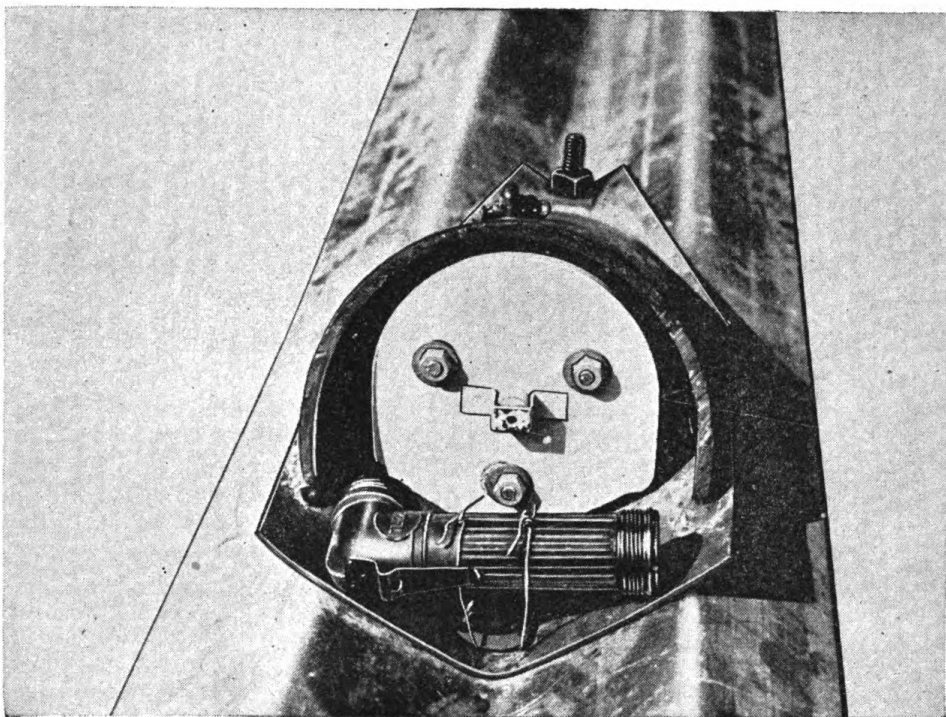


Figure 23.06. M1 bullet impact fuze illuminated by flashlight.

23.07. Safety Precautions

When a demolition snake is detonated, the blast pressure is least toward the rear and is greatest on the flanks of the snake. Blast pressure from the detonation causes the tank crew no discomfort. If the snake is fired immediately after it is released by the tank, flame from the explosion may enter the tank, if any ports are open. However, there will be no damage to the tank or injuries to personnel, if safety precautions listed below are observed. Detonation may throw fragments as far as 1,000 yards laterally or 300 yards to the rear, but most of the fragments are thrown at right angles to the line of the snake. The following precautions must be taken when handling snakes:

a. Pushing and towing tank. (1) All loose oil and fuel drippings must be removed from inside tank.

(2) Tank fire extinguishers must be in good working condition and ready for use.

(3) Pistol port must be locked securely.

(4) All direct-vision slots must be closed.

(5) Fuel-tank filler covers must be properly fastened.

(6) Gaskets and latches on all hatch covers must be in good condition.

(7) Hatch doors must be securely latched. Detonation of a snake will blow open improperly latched hatch covers.

(8) Periscope must be fitted in all periscope holders.

(9) Smoke mortar and turret and bow machine guns must be in place or wooden plugs wedged in openings.

(10) Canvas or asbestos should be stuffed around hull and turret ventilators to minimize dirt blowing into tank.

(11) Canvas or asbestos should be stuffed in gun-shield opening behind rotor shield to prevent flame from explosion from entering tank.

b. TANKS CLOSE TO TANK PUSHING OR FIRING DEMOLITION SNAKE.

(1) The minimum safe lateral distance for tanks is 100 yards.

(2) Tanks within 500 yards should have all ports and slits closed, and all hatch doors securely latched.

c. PERSONAL OUTSIDE OF TANKS. (1) No personnel must be within 250 yards of snakes in firing position or armed snakes being towed or pushed.

(2) Personnel must *take cover* when 250 to 800 yards away laterally or 250 to 300 yards to the rear of an armed snake.

23.08. Towing and Pushing

The average tank driver requires 1 week of daily practice in pushing and towing inert demolition snakes (loaded with tamping material) to become proficient. Before a live snake is towed or pushed, precautions listed in paragraph 23.07a must be taken.

a. TOWING. (1) Align the tank with the demolition snake in front of the nose and back in up until the towing yoke is behind and above the towing hook. Take care not to back over the nose and crush it. The bow gunner releases the cable holding the towing yoke and the yoke falls into the snake behind the towing hook. The tank then moves forward slowly until the yoke engages the hook. Towing assembly is shown in figure 23.05a.

(2) When towing a demolition snake, it is important that changes in direction and speed be made gradually and without jerking.

(3) Tow the demolition snake as close as possible to the obstacle. The last 400 feet of the tow must be as straight as possible, so the snake will take a straight course when pushed into the obstacle. When the snake is to be dropped, stop the towing tank and back it up about 2 feet to disengage the yoke from the towing hook. Raise the yoke by cranking up the cable on the periscope fitting. The yoke is raised much faster using the ratchet wrench with 1-inch socket in the tank tool kit rather than the wrench furnished with the snake. Then move the tank forward far enough to clear the nose of the snake before turning.

b. PUSHING. (1) *Alignment.* To push a demolition snake, approach the tail of the snake and align the tank astride the snake. Practice is

required to align the center of the tank with the snake, because the driver is seated off center and his view is restricted. Pronounced misalignment may cause the snake to buckle during pushing.

(2) *Engaging pushing hook.* Before reaching the tail ramp, the bow gunner releases the pushing chain. (See fig. 23.05b). The tank then advances slowly until the chain engages the pushing hook and the hook is picked up and held against the belly of the tank.

(3) *Starting push.* After picking up the hook, the tank starts forward in lowest gear and slowly accelerates until it is running in second or third gear. Alignment of the center of the tank over the center of the snake must be preserved and the driver must follow the snake carefully, making no attempt to guide it. Attempts at guiding usually cause structural failure of the plates immediately in front of the tank.

(4) *Observation by tank driver.* The driver must frequently manipulate the periscope to observe the terrain ahead, the behavior of the nose, the relative alignment of the tank with the snake, and the condition of the snake near the tank. The entire length of a 400-foot snake is seldom completely within the limited field of vision of the periscope.

(5) *Releasing demolition snake.* To release the snake, back the tank up far enough to clear the chain from the hook. The chain is pulled up by hauling in on the control rope.

23.09. Detonation

The flash of flame produced by detonation of the aluminum M3 demolition snake is greater than that produced by detonation of the steel M2 and M2A1 models. It may extend back to the tail of the snake, and, if the snake is detonated immediately after the tank disengages from the pushing hook, the tank may be partially enveloped in flame for an instant. A number of snakes have been fired with the tank in this position without injuries or damage. All precautions listed in paragraph 23.07a were taken. It is preferable, after dropping the snake, to back the tank up about 40 feet before detonation. However, the snake can be fired while pushing, without stopping to unhook or back up, and the tank can immediately advance through the cloud of smoke and dust raised by the explosion, the driver feeling his way through the crater.

a. **BULLET IMPACT FUZE.** The demolition snake is normally detonated by firing at one of the fuzes mounted on the snake with either tank machine gun. Two fuzes are provided because the position of the snake may place one of the fuzes where it is difficult to see or hit. The coaxially-mounted machine gun is generally the better gun to use because it is mounted higher in the tank. In medium tanks, where the periscope fitting is inserted in the hatch cover, the bow gunner is blind and the

coaxial gun must be used. (See par. 23.05c (2).) Tracer ammunition must be used when firing at night with the fuzes illuminated. (See fig. 23.06.)

b. **TANK 75-MM GUN.** If neither fuze can be hit by machine-gun fire, the demolition snake is detonated by a direct hit from the 75-mm or 37-mm gun, using a high-explosive shell with superquick fuzing. The snake will explode when any loaded section is hit. Fire should not be directed at the rear 60 feet, which contains no explosive.

23.10. Effectiveness of M3 Demolition Snake

a. **MOST SUITABLE TERRAIN.** Demolition snakes are most effective in flat or moderately rolling, open, or lightly wooded terrain. Such terrain, moreover, is suitable for maneuvering tanks.

b. **CRATER.** The size of the crater blasted by a demolition snake depends on the type of soil and its moisture content. In most soils, the crater will be 320 feet long, 12 to 16 feet wide, with maximum depth of 3 to 5 feet. The crater provides a well-marked route for tanks.

c. **BREACHING OBSTACLES.** (1) The principal use of demolition snakes is breaching mine fields; however, they may also be used to breach bands of log posts, steel rails, antitank ditches, and some small concrete obstacles. Effectiveness of the snake depends on type, shape, height, weight, and spacing of the individual obstacles; ground characteristics; and depth obstacles are emplaced in ground. The snake is either pushed through or over the obstacles. Length of snake used depends on the depth of the obstacle. When fired, the entire section of snake in the obstacles must be loaded with explosives. When the snake is detonated, a crater is blasted and the obstacles in the crater are generally shattered or blown out of the crater, depending on the characteristics of the obstacle.

(2) Against reinforced-concrete obstacles interconnected by ground sills and against large reinforced-concrete blocks, detonation of a single demolition snake may not produce an adequate breach, because of the weight and strength of the blocks and because good contact of explosives with surface of concrete is not obtained.

(3) Success in breaching antitank ditches depends on the depth, width, and revetting of the ditch, and whether the nose of the demolition snake clears the far side of the ditch. Detonation of a demolition snake breaks down the sides of the ditch. In average, unrevetted ditches 5 feet deep, a single snake will blast a gap passable by tanks. Deeper ditches may require the detonation of a second snake in the crater of the first. It is generally not practicable to breach ditches deeper than 8 feet.

23.11. Comparison of Demolition Snake Models

a. Principal differences between M2, M2A1, and M3 demolition snakes are tabulated below :

	M2	M2A1	M3
Total net weight	12,500 pounds	15,000 pounds	9,000 pounds.
Corrugated plates	Steel 53 pounds 164	Steel 53 pounds 172	Aluminum. 16 pounds. 200.
Washers	1 per bolt 2 inches long	1 per bolt 2 inches long	2 per bolt. 4 inches long.
Nose	Steel Two-piece, bolted Held to adapter by bolt.	Steel Two-piece, bolted Held to adapter by special retainer.	Aluminum. One-piece, welded. Held to adapter by special retainer.
Tamping bags	Paper	Paper	Cloth or paper.
Pushing attachment	Wire rope	Steel chain	Steel chain.
Total explosive load	3,200 pounds	4,500 pounds	4,500 pounds.
Explosive cartridges	4 feet long 20 pounds explosives. Steel casing Circular in cross-section.	5 feet long 35 pounds explosives. Aluminum casing Elliptical in cross-section.	5 feet long. 35 pounds explosives. Aluminum casing. Elliptical in cross-section.
Fuze and shield	1	2	2
Towing assembly and rigging.	Rope on towing yoke raised by hand.	M2 fittings and rigging improved and strengthened. Cable on towing yoke raised by winch on periscope fitting.	M2 fittings and rigging improved and strengthened. Cable on towing yoke raised by winch on periscope fitting.

b. Assembly procedure for M2 and M2A1 demolition snakes is similar to that of the M3 snake; however, lapping of the steel plates differs from that prescribed for aluminum plates. (See fig. 23.11a.)

c. With M2 and M2A1 demolition snakes, the expedient nose (fig. 23.11b) can be used in place of the standard pear-shaped nose and adapter. It is built from steel body plates and is fastened to the two foremost bolt holes of the assembled snake. This nose is better adapted for pushing snakes over obstacles presenting a vertical face of limited height.

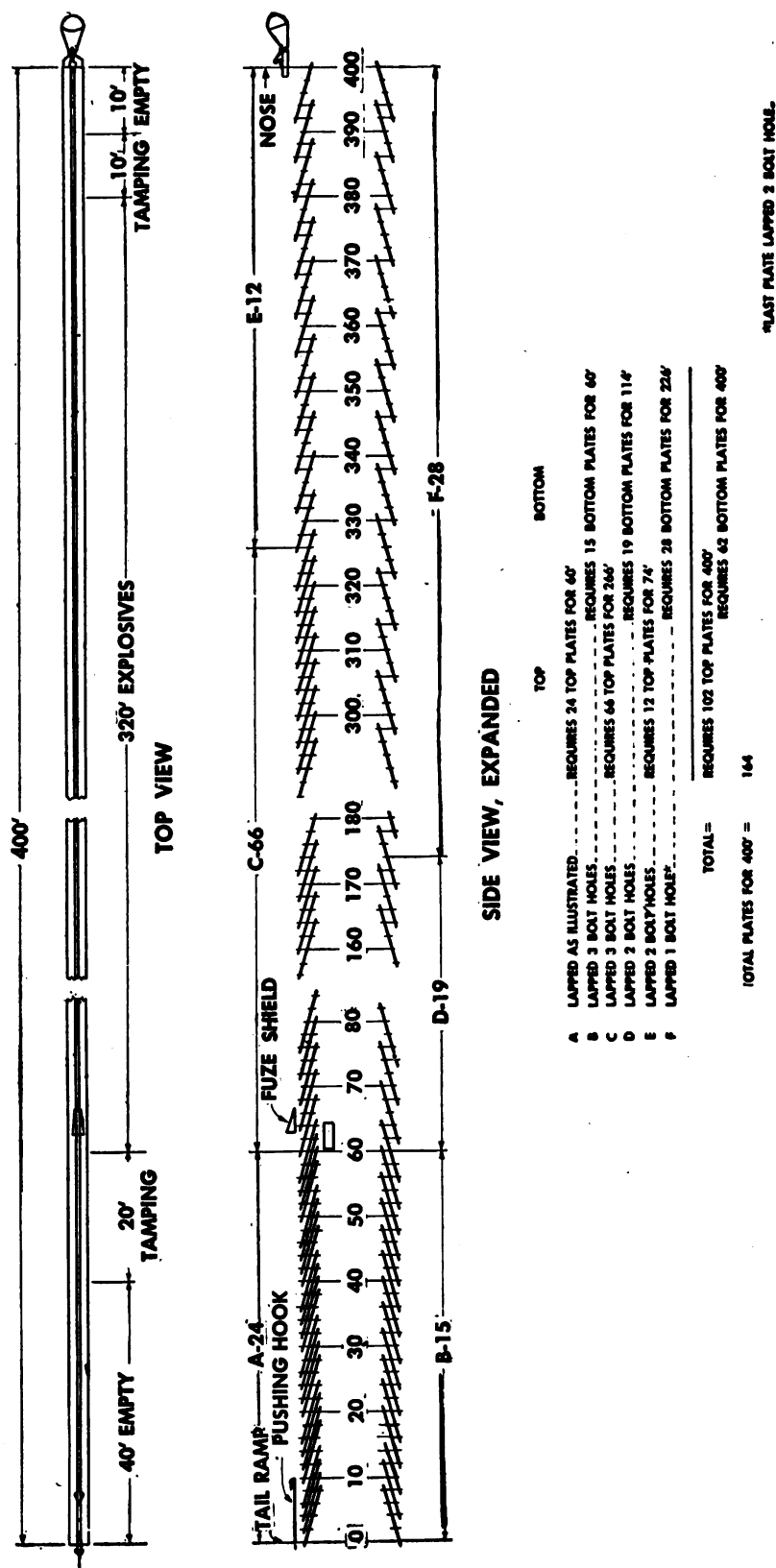


Figure 23.11a. Assembly diagram for M2 and M2A1 snakes.

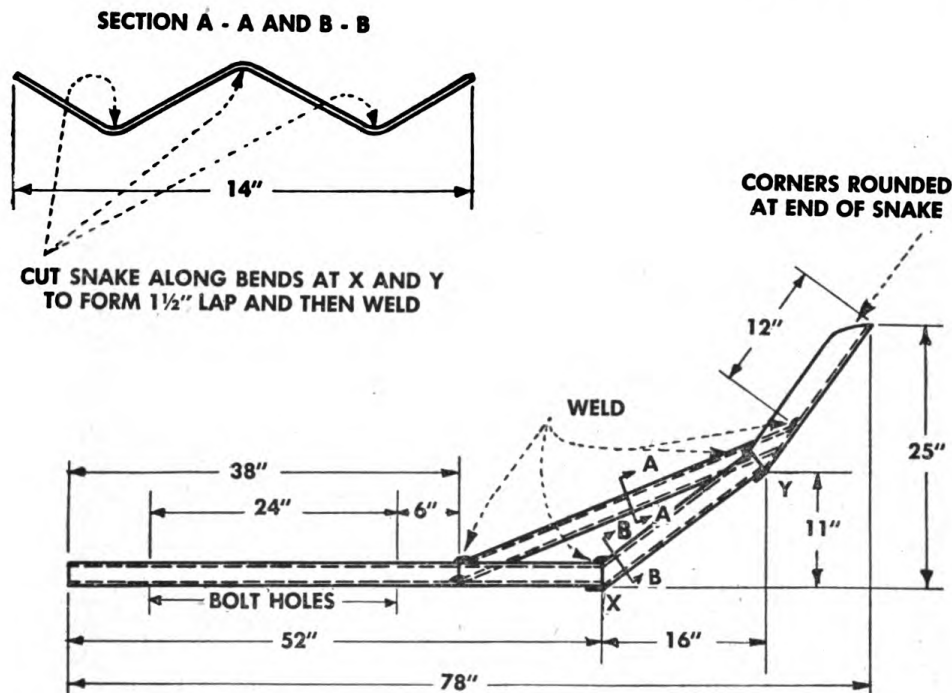


Figure 23.11b. Expedient nose for M2 and M2A1 demolition snakes.

Section IV. PROJECTILES

24.01. Artillery and Tank Gunfire

At point-blank range, several well-placed rounds from a tank 75-mm gun reduce small concrete obstacles such as cubes and dragon's teeth. The number of rounds required depends on size of the obstacle, quality and reinforcing of the concrete, type of ammunition used, and accuracy of the gunner. The most effective ammunition is high-explosive fitted with M78 concrete-piercing fuze. When this fuze is not available, two or three armor-piercing rounds are fired, followed by high-explosive. Fire from other artillery pieces is effective, depending on the type of piece and ammunition used. The 75-mm tank gun can be used in the rapid demolition of antitank walls by firing several armor-piercing rounds into the wall; a demolition crew then fills the holes with plastic explosive or prepared TNT charges, which are detonated to complete the breach. Artillery or tank gunfire is not used to complete the breach because of the large quantity of ammunition needed.

24.02. Effect of Projectiles on Fortifications

a. The best types of artillery fire against permanent concrete fortifications are high-velocity armor-piercing projectiles and high-explosive pro-

jectiles with special concrete-piercing nose fuzes (T-105 CP fuze), fired at short range by direct-laying weapons. Long-range indirect fire is ineffective against pillboxes. High-explosive projectiles with standard fuzes are not effective against concrete pillboxes; however, they may be used with armor-piercing rounds to clear away weakened and shattered concrete. High-explosive rounds entering an opening are effective within a pillbox.

b. For more detailed information on the capabilities of weapons and ammunition, see TM 9-1907 and FM 31-50.

24.03. 7.2-inch Demolition Rockets

a. The M17 7.2-inch multiple rocket launcher, mounted above the turret of a medium tank, holds 20 T37 demolition rockets, each containing about 33 pounds of composition C-2. The 20 rockets can be fired, by means of a firing mechanism inside the tank, in less than 10 seconds. The rockets can be used to demolish antitank walls and all types of individual concrete, steel, and log obstacles. In general, steel obstacles are hard to hit and better results are obtained on fence type obstacles such as element C by firing diagonally to prevent the rockets from passing completely through the obstacle without hitting a steel member. Two or three effective rounds reduce small concrete obstacles. About 15 effective hits are required to breach a nonbackfilled reinforced-concrete wall 6 feet high and 6 feet thick. About seven hits are needed to breach 6-foot-high back-filled coral, log, or stump walls. For accurate fire, the tank must be within 30 yards of obstacles.

b. TM 9-396 gives detailed information on the launcher.

CHAPTER 3

MECHANICAL MEANS OF DISPOSING OF OBSTACLES

Section I. ENGINEER ARMORED VEHICLE**31.01. General**

The engineer armored vehicle (fig. 31.01) is a medium tank of the M4 series modified to suit engineer needs. The M4A3 tank is the easiest to convert and has the best operating characteristics for engineer work. The hull of the tank is modified to permit easy entrance and exit by demolition and work parties, to give more room in the turret, and to provide control of attached devices.

a. ATTACHMENTS AND FITTINGS. The steel fittings and special welding rod necessary to convert a medium tank to a basic engineer armored vehicle are contained in a conversion kit. In addition, fittings for attaching such accessories as the tank bulldozer, rocket launcher, and 81-mm mortar may be welded or bolted to the armored vehicle. Other devices such as the charge placer, pallet, or demolition snake may be hooked to or placed on it. These accessories and supplementary devices may be put on or taken off a tank or engineer armored vehicle as required for a particular mission.

b. CONVERSION EQUIPMENT. (1) The trailer-mounted welding equipment set and the general-purpose shop truck, both organic equipment of the engineer combat battalion, are used to convert a medium tank to a basic engineer armored vehicle in the field.

(2) Instructions for modifying a medium tank to a basic engineer armored vehicle are packed with each conversion kit.

31.02. Basic Vehicle

a. CREW. The normal crew of the engineer armored vehicle consists of four demolition men in the turret, a driver, and an assistant driver.

b. STOWAGE OF EXPLOSIVES. Explosives are best stowed on the turret-basket floor. One thousand pounds of composition C-2 in 18-pound packs or tetrytol in 20-pound packs can be conveniently placed on the floor and still leave room for the four demolition men. An additional 300 pounds

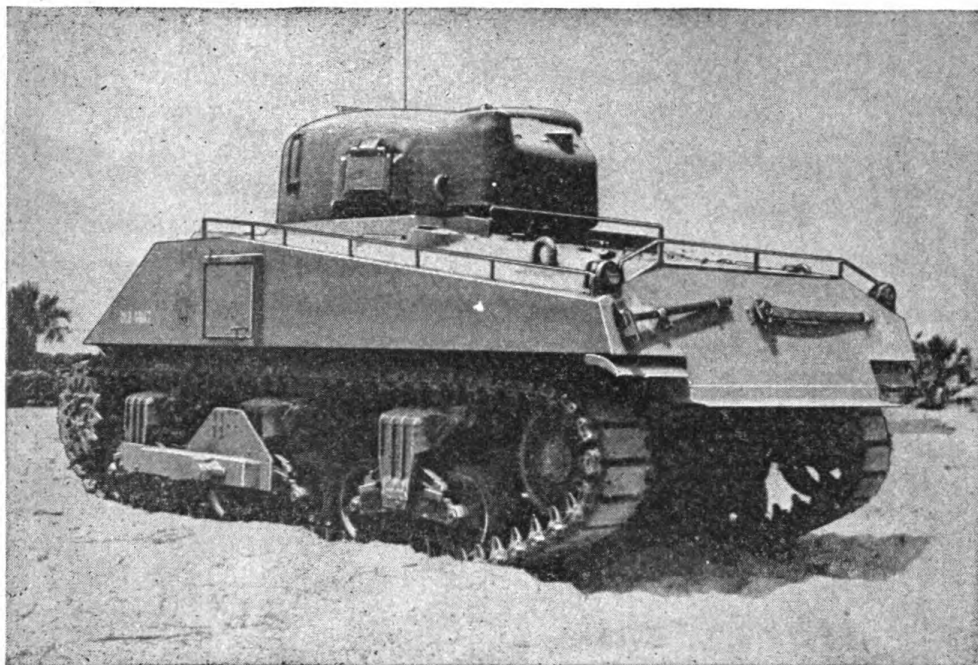


Figure 31.01. Basic engineer armored vehicle, converted from M4A3 medium tank.

of explosives can be carried on the right sponson (space inside tank above track) and 700 pounds can be stacked on the right side under the turret-basket floor plates. A $\frac{3}{8}$ -inch steel rod welded in the vehicle (location depending on the model of the tank) aids in lashing explosive in place. When cases of TNT are carried, the capacity is less because of the size and shape of the boxes.

c. HULL MODIFICATIONS. (1) *Doors.* A door is added on each side of the hull so the demolition men can get in and out and unload explosives faster. Simple platforms of 1-inch lumber (fig. 31.02a) fitted between the turret basket and side door make it easier to get in and out of the vehicle. It is best to enter feet first and to leave head first. (See fig. 31.02b.)

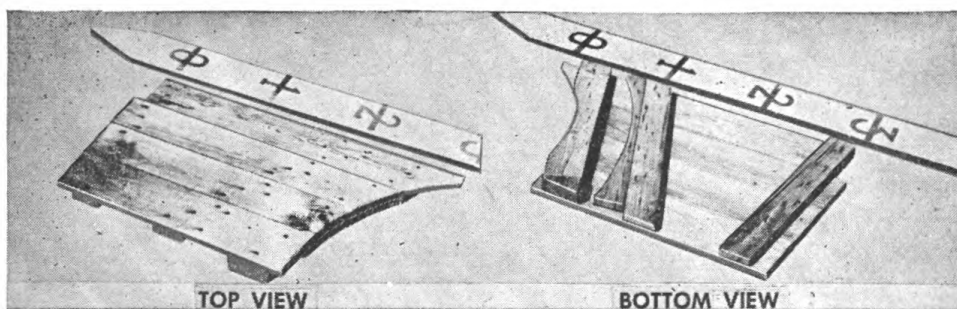


Figure 31.02a. Wooden platform to assist in getting in and out of engineer armored vehicle.

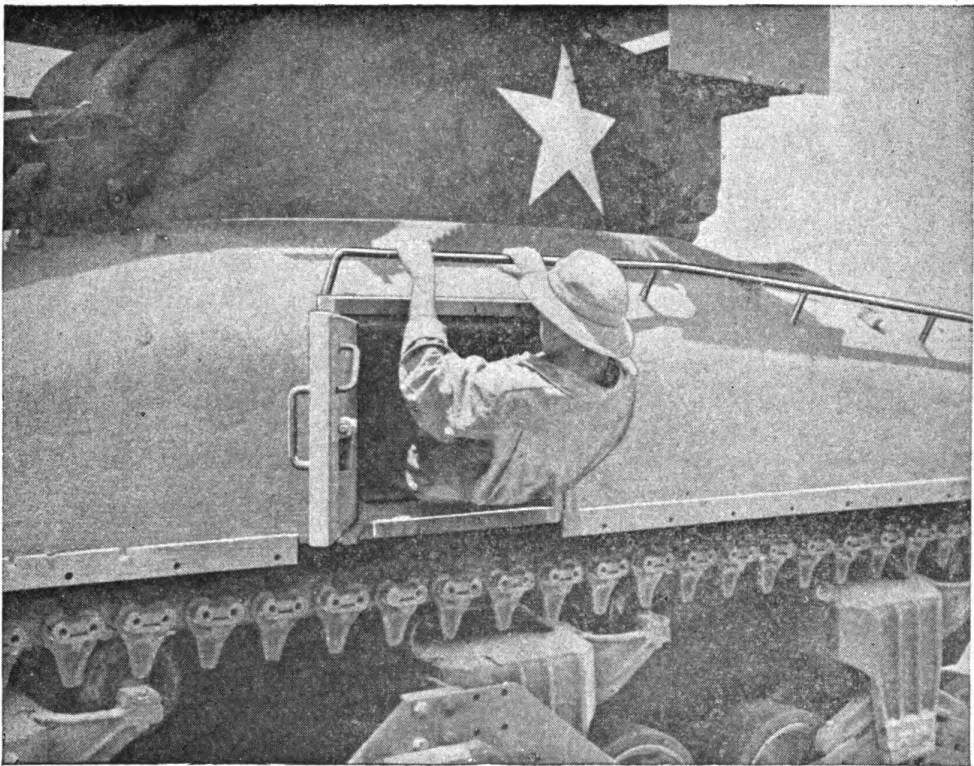


Figure 31.02b. Proper method of entering or leaving engineer armored vehicle.

(2) *Handrails.* The handrails above the side doors are used when climbing in and out of the engineer armored vehicle. The rails on the rear of the hull are used for lashing on supplies and afford footholds and handholds for men riding on the vehicle.

(3) *Rear step.* The rear step can be used by personnel riding or climbing on the vehicle or to carry supplies. It must be removed when the vehicle is waterproofed.

(4) *Other modifications.* Ammunition racks, part of the turret basket, and the 75-mm gun tube and part of its mounting are removed to give more room inside the vehicle. An adapter is welded on the gun apron for mounting the M17 rocket launcher.

d. *RADIO.* The SCR-528, a frequency-modulated (FM) set, is recommended for use in the engineer armored vehicle, since it can operate in the same net with radios installed in medium tanks and vehicles of the armored engineer battalion. The radio is installed in the same way as in a medium tank, no modifications being necessary. The interphone system can be used with the SCR-528.

e. *USES.* (1) The engineer armored vehicle gives protection against small-arms fire, shell fragments, and antipersonnel mines. The armor protects a demolition party attacking an obstacle during the move to the objective and to some extent while the charges are being placed. For

maximum protection and efficiency, it is usually best to use two vehicles.

(2) When using two vehicles to breach a gap suitable for passage of tanks in a reinforced-concrete wall 10 feet high and 8 feet thick, the procedure is as follows:

(a) The two vehicles approach the wall as close as possible and, facing slightly to the flanks, they stop about 30 feet apart.

(b) Three demolition men get out of each vehicle on the protected side and set up two empty explosives boxes against the wall about 6 feet apart. A 2- by 8-inch board 10 feet long is placed on the boxes so the charge will be elevated about 2 feet.

(c) The fourth demolition man remains inside the vehicle and tosses 750 pounds of explosive out the side door. The three men outside the vehicle stack the explosives on the board against the wall.

(d) After the 1,500-pound charge is placed and primed, the men get back in the vehicle. The last man to leave, a noncommissioned officer, pulls all fuse lighters. Enough time fuse is used to give a 2-minute delay.

(e) With all slits, ports, and doors closed, vehicles back away 75 to 100 yards to await the explosion.

(f) With two vehicles, a 1,500-pound charge can be placed in 3 to 4 minutes.

(3) The crew of one vehicle can place a 1,000-pound charge in 3 to 4 minutes. (See fig. 31.02c.)



Figure 31.02c. Placing wall charge from engineer armored vehicle.

31.03. Tank Bulldozer

The tank bulldozer is a tank or an engineer armored vehicle with a modified D8 dozer blade mounted on its front. The tank bulldozer is described in detail in paragraphs 33.01 to 33.09, inclusive.

31.04. M17 Rocket Launcher

The M17 rocket launcher can be used to blast gaps through antitank walls, individual concrete or steel antitank obstacles, and barbed-wire entanglements. Information on the M17 rocket launcher is given in paragraph 24.03 and in TM 9-396.

31.05. Dozer-placed Antitank-wall Charges

a. DESCRIPTION. The dozer blade can carry a large explosive charge of 1,000 pounds or more up to an antitank wall and drop it off against the wall. In the field, the frame which carries the charge may be built of lumber or small angle irons and channels. The frame consists of a rack to hold the explosive and a supporting structure which hooks over the dozer blade. The supporting structure has legs to hold the rack up against the wall, shoes to prevent the legs sinking into the ground, and support arms which hold the rack and hook over the dozer blade. The surface area of the shoes and the length of the legs may require adjustment to suit soil conditions. (See figs. 31.05*a* and 31.05*b*.)

b. USE. (1) The charge carrier is used to breach gaps for tanks through antitank walls. To breach a 6-foot-thick wall, a 1,000-pound charge, 9½ feet long, 22 inches high, and 8 inches thick is placed against the wall 2 feet off the ground. Good contact of explosives is obtained on verticle and sloping walls. (See figs. 31.05*c* and 31.05*d*.)

(2) The charge carrier is simply constructed and a charge can be placed in a few seconds. However, it is vulnerable to hostile fire. This disadvantage may be minimized by preceding the charge-carrying vehicle with one or two medium tanks, which turn aside when close to the wall. After the blast, the dozer is immediately available for improving the gap.

(3) It is essential that tank drivers be well-trained in dropping off charges against practice walls while the tank is buttoned up.

c. PREPARING THE CHARGE. The blade is raised and the charge carrier is hooked to it. The rack is loaded with an 8-inch thickness of explosives, preferably 18-pound packs of plastic explosive or 20-pound tetrytol packs. The packs are lashed in pairs to the back of the framework with sash cord, marlin, or wire. Thin pieces of wood are taped or tacked to the upper support arms, so the charge carrier is dropped the correct distance from the wall. The length of these sticks depends on the angle of the wall and the slope of the ground. Against a vertical wall on level ground use sticks about 2½ feet long. One foot of this length is used for attach-

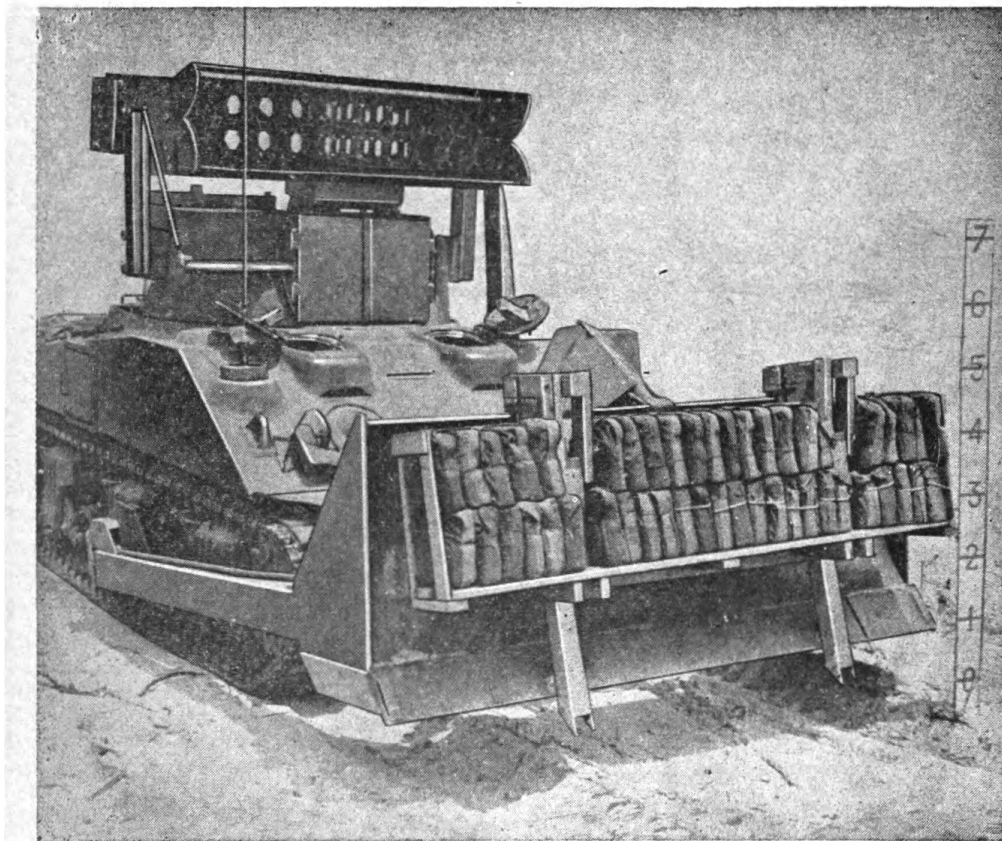


Figure 31.05a. Loaded wooden charge carrier carried on dozer blade.

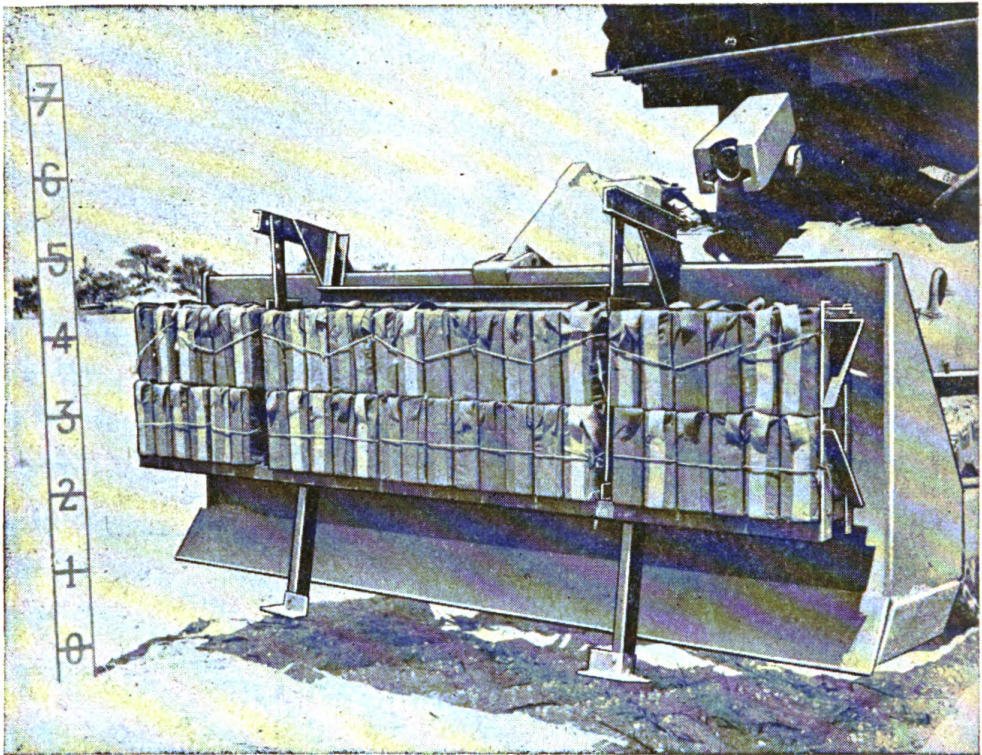


Figure 31.05b. Loaded steel charge carrier carried on dozer blade.

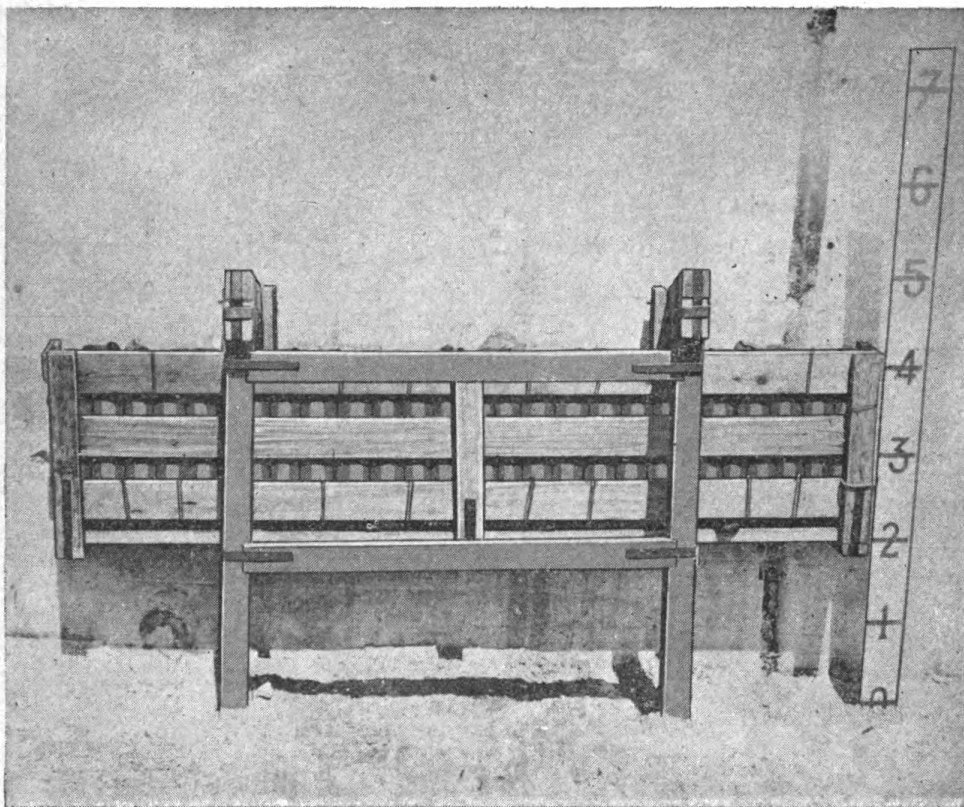


Figure 31.05c. Wall charge placed with wooden charge carrier.

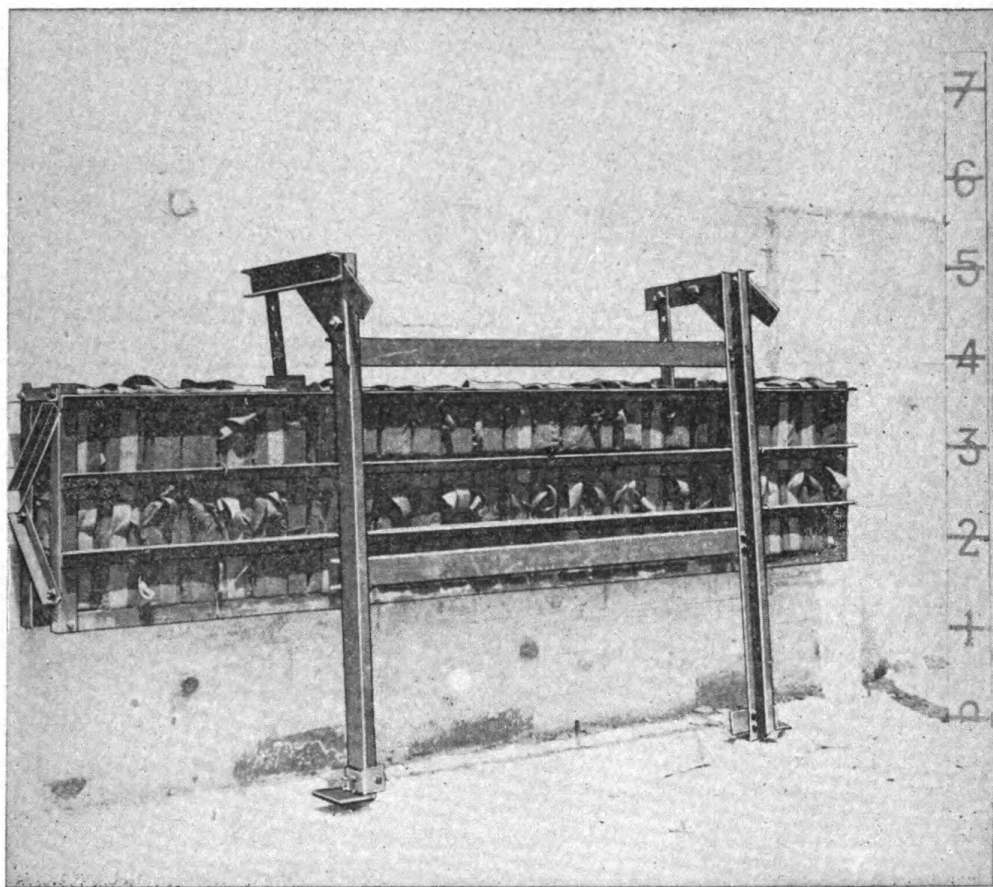


Figure 31.05d. Wall charge placed with steel charge carrier.

ing to the support arm, leaving a 1½-foot projection in front. When the ends of the sticks touch the wall, the driver drops the charge. Should ground be uneven, charge may not unhook easily from blade.

d. PLACING THE CHARGE. The charge carrier and charge is dropped while all slits, ports, and doors of the tank are closed. In the approach, the driver raises the blade enough so the charge carrier legs are not damaged on uneven ground. The last 15 feet of the approach are covered slowly to minimize the chance of ramming the wall and crushing the charge carrier. When the ends of the projecting sticks touch the wall, the driver lowers the blade gradually until the legs rest on the ground. When wall height is less than 5 feet, projecting sticks will not strike the wall, and the operator must rely on previous training in such a situation. The charge carrier unhooks automatically from the blade, and the charge falls forward against the wall. The ground must be comparatively level or the charge carrier may not unhook properly. After the charge carrier is placed, the vehicle backs away at least 75 yards and the charge is fired.

e. FIRING THE CHARGE. At least two firing circuits should be used to assure detonation of the charge. The following methods of firing may be used:

(1) *Electric.* An electric firing cable is payed out as the vehicle backs away and the charge is fired when the vehicle is at a safe distance.

(2) *Fuse lighter.* The charge is primed in two or three places with fuse lighters and about 40-second lengths of time fuse. The fuse lighters are fastened securely to the charge carrier frame. Strong cord or wire is tied to the pull rings of the fuse lighters and to the dozer frame. When the vehicle backs up about 6 feet, the fuse lighters are fired.

(3) *Target.* A target firing device is placed in the center of the back of the charge. A bullet impact fuse from a demolition snake may be used or one may be improvised from denotating cord. When the vehicle has backed up a safe distance, a burst from the tank caliber .30 machine gun directed at the target fires the charge.

f. CONSTRUCTION. (1) *Steel charge carrier.* The rack and frame of the steel charge carrier are shown in figures 31.05e and 31.05f. The assembled unit hung from a dozer blade is shown in figure 31.05g. Construction details and a bill of material are given in figure 31.05h.

(2) *Wooden charge carrier.* The wooden charge carrier is constructed on the same principles as the steel model and is handled and placed in the same manner. It is not as rugged as the steel device, but will serve when steel is not available. Figure 31.05i is a bill of material and construction drawing for the wooden charge carrier. Figure 31.05j shows the completed device carried on the dozer blade.

31.06. Demolition Snake

Demolition snakes can be used with the engineer armored vehicle. The

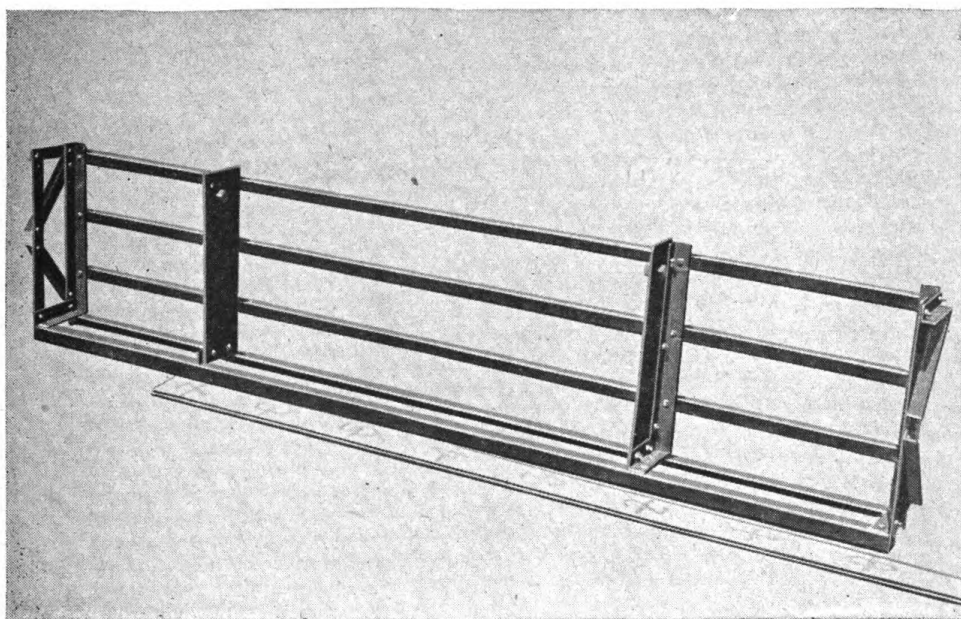


Figure 31.05e. Rack of steel charge carrier.

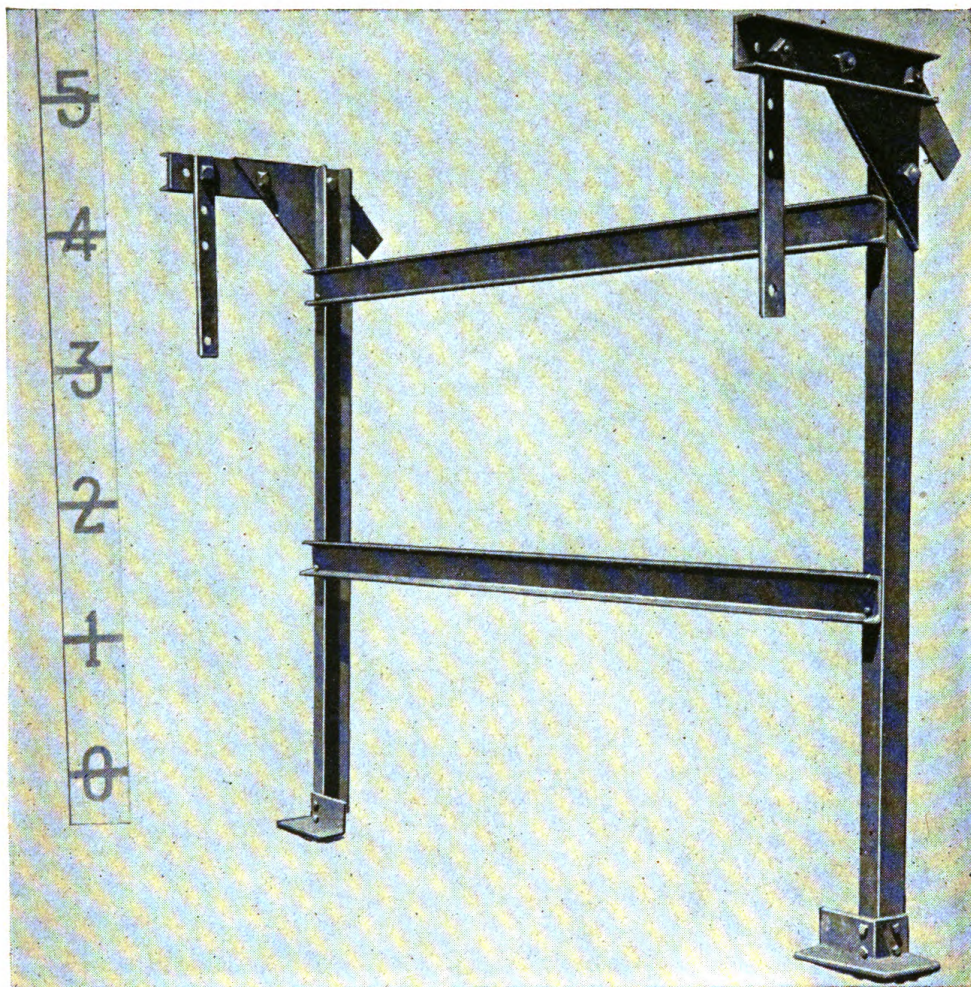


Figure 31.05f. Supporting frame of steel charge carrier.

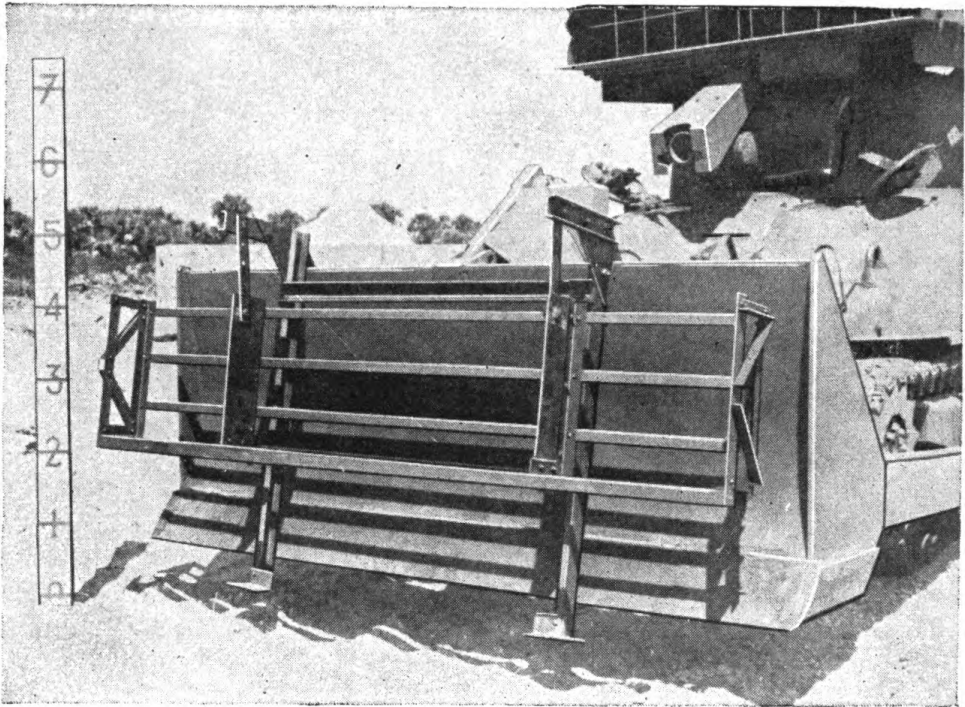
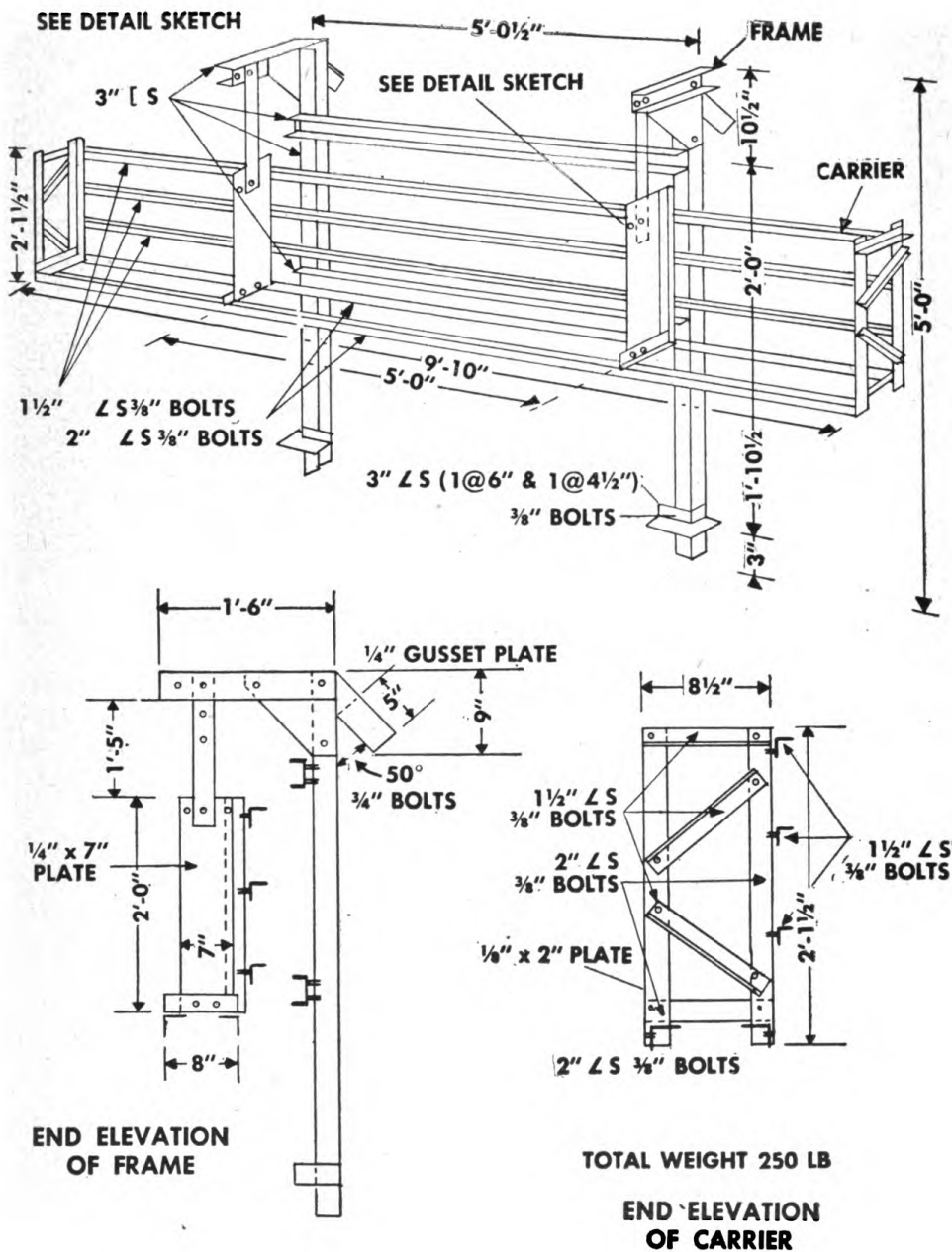
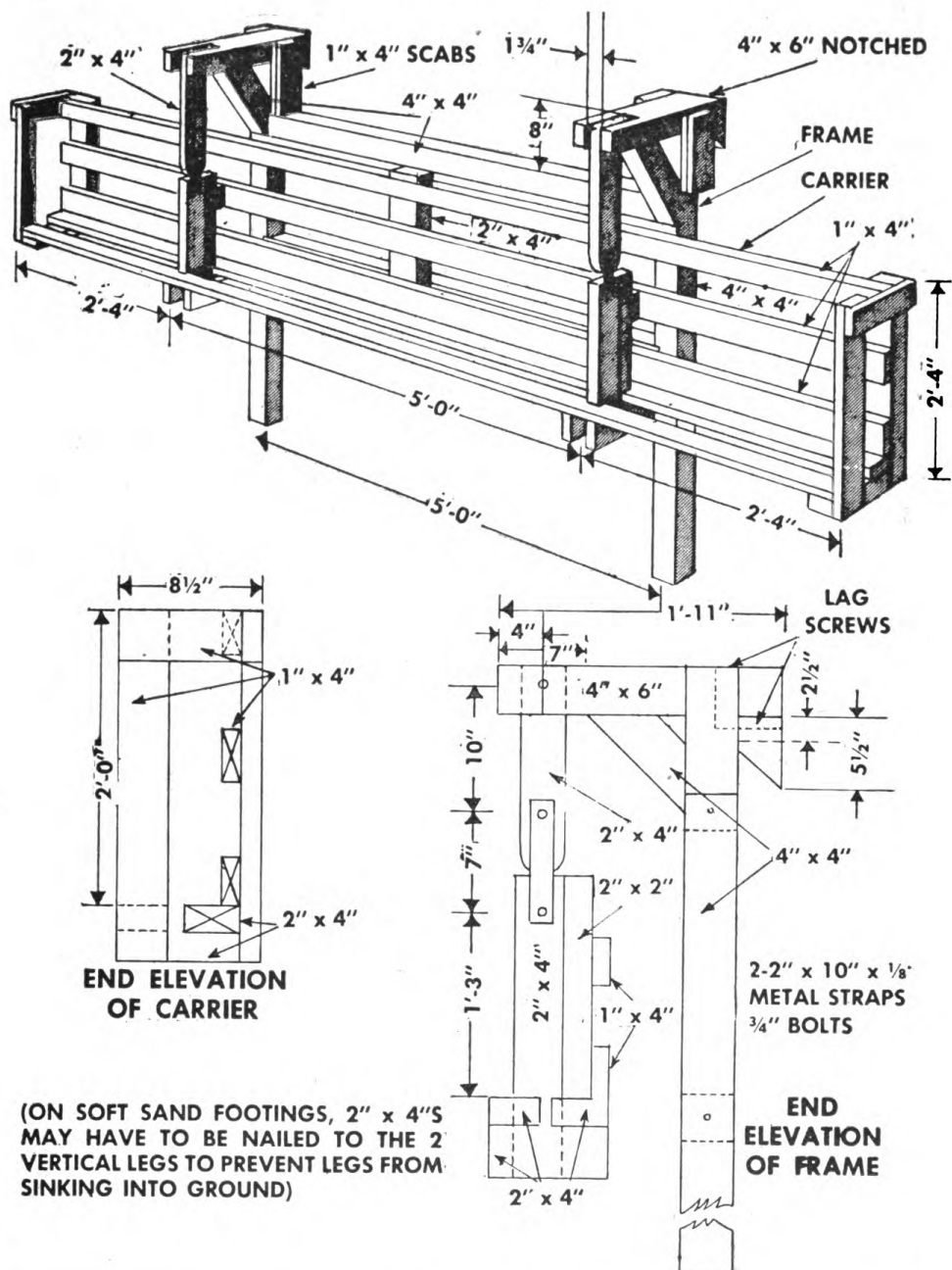


Figure 31.05g. Steel charge carrier carried on dozer blade.



BILL OF MATERIALS							
NO PCS		SECTION	LENGTH	NO PCS		SECTION	LENGTH
2		3" L 4.1 LB	5'-0½"	3		1½" L 1.23 LB	9'-10"
2		"	5'-0"	4		"	1'-0"
2		"	1'-6"	2		"	0'-8½"
2		3" L 4.9 LB	0'-6"	2		¼" x 2" PL	1'-5"
2		"	0'-4½"	2		¼" x 7" PL	2'-0"
2		2" L 1.65 LB	9'-10"	2		¼" GUSSET	PLATE
2		"	2'-1½"	2		⅛" x 2" PL	2'-1½"
2		"	2'-0"	10		¾" BOLTS	1½"
4		"	0'-8"	64		¾" BOLTS	1"

Figure 31.05h. Construction details and bill of material for steel charge carrier.



MATERIALS--ONE DOOZIT			
QUANTITY	SIZE	LENGTH	ITEM
4 PCS.	1" x 4"	12'	1 x 4 S4S
4 PCS.	2" x 4"	10'	2 x 4 S4S
2 PCS.	4" x 4"	12'	4 x 4 S4S
1PC	4" x 6"	4'	4 x 6 S4S
8 EA.	1/2"	7'	LAG SCREWS
4 EA	3/4"	3"	BOLTS
2 EA	3/4"	6"	BOLTS
4 EA	1/8" x 2"	10"	METAL STRAPS
			ASSORTED NAILS

Figure 31.05i. Construction details and bill of material for wooden charge carrier.

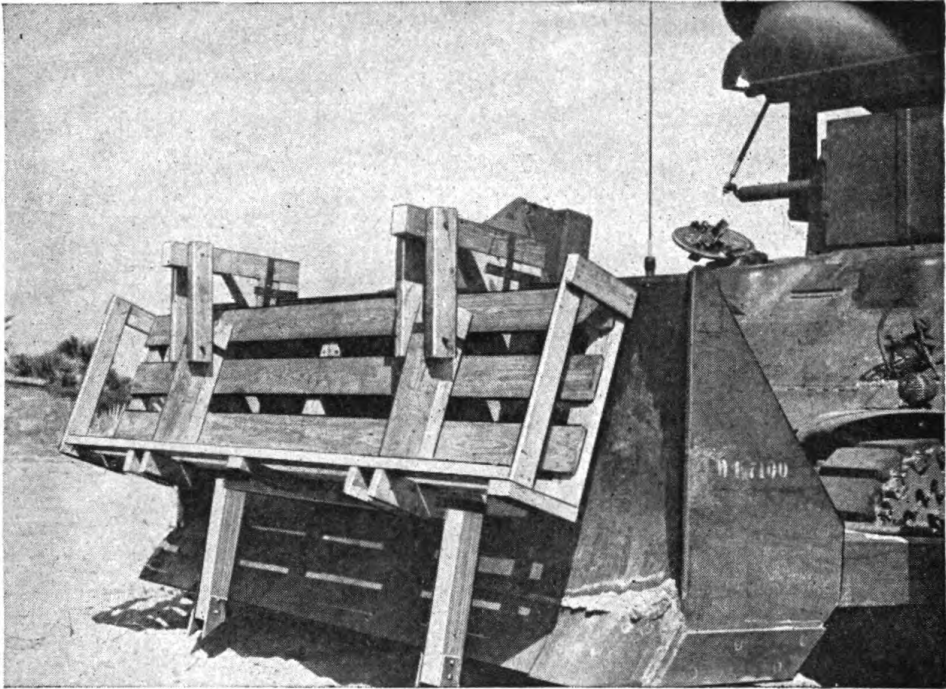


Figure 31.05j. Wooden charge carrier carried on dozer blade.

dozer hydraulic-jack assembly must be removed from the vehicle so the snake pushing cable can be installed on the front towing lugs. Demolition snakes are discussed in paragraphs 23.01 to 23.11, inclusive.

31.07. Toboggan-type Pallet

a. DESCRIPTION. The toboggan type pallet (fig. 31.07a) is a rugged sled about 4 feet wide by 8 feet long with a low center of gravity. The pallet is hooked by its $\frac{5}{8}$ -inch towing cable to the trailer pintle hitch on the vehicle and towed about 6 feet behind the vehicle. It can readily be built in the field.

b. USE. (1) The pallet is useful when all the explosives or supplies required cannot be carried inside the armored vehicle. It is suitable for assault work because of its low silhouette, ability to cross rough ground, ease of jettisoning from inside the vehicle and of unloading, and because, when empty, it is no obstacle to an armored vehicle backing up.

(2) When it is undesirable to leave the engineer armored vehicle standing in front of an obstacle, the pallet may be used to advantage to haul explosives. The armored vehicle need halt at the obstacle only long enough to unload the demolition men and jettison the pallet. It can then be driven off while the men prepare the demolition.

(3) One layer of seventy-four 18-pound packs of composition C-2, packed with the 11-inch dimension vertical, can be carried on the pallet. The over-all height is 14 inches and the total weight of explosive is 1,332

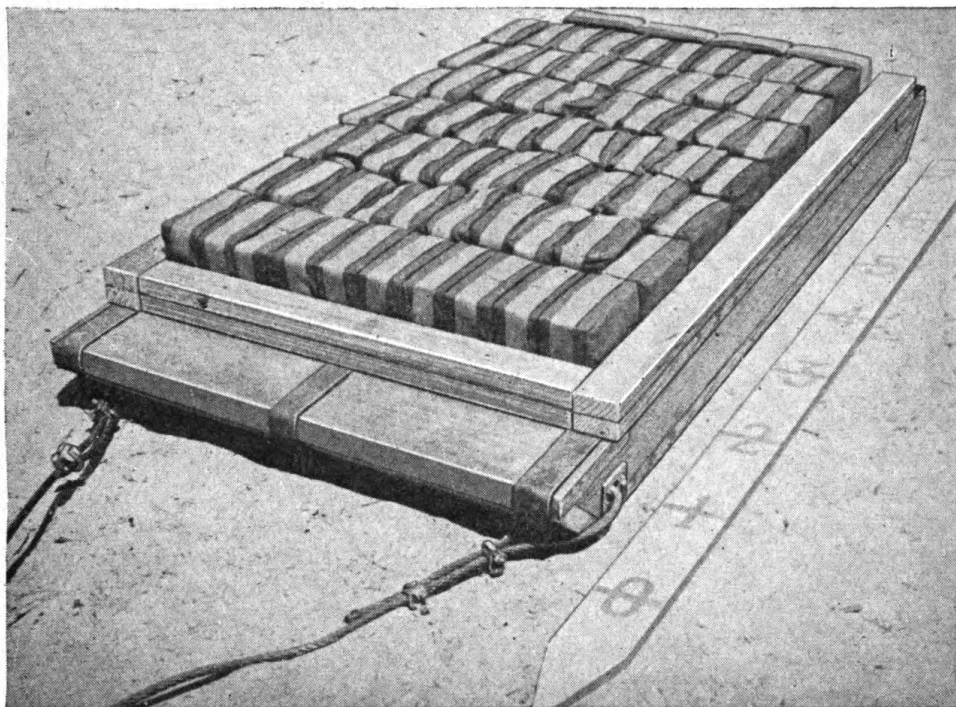
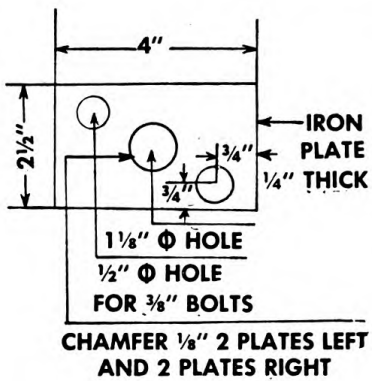
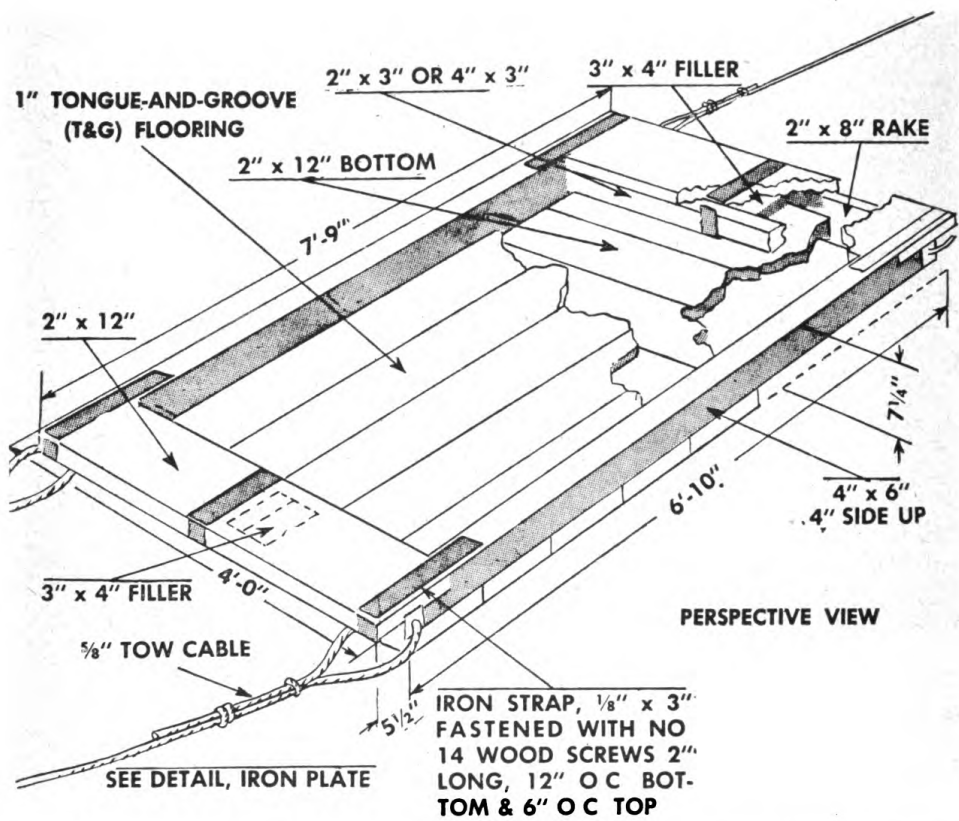


Figure 31.07a. Toboggan type pallet loaded with explosives.

pounds. To prevent the packs dislodging during hauling, 4- to 4-inch timbers are nailed on all four sides. (See fig. 31.07a.) Any space between the sides of the pallet and the load should be filled in by wedging in lengths of 1-inch lumber. When properly loaded, the pallet can be hauled over most terrain that can be negotiated by the armored vehicle. The vehicle driver should avoid stumps and similar obstructions.

(4) A pallet loaded with explosives may be dangerous when towed over mined areas. In tests, a $\frac{1}{2}$ -pound block of TNT, simulating an anti-personnel mine, detonated under an explosive-filled pallet, scattered the explosives and broke up the pallet. Twelve pounds of TNT, simulating an exploding antitank mine, detonated the explosives loaded on the pallet. However, it is unlikely that the weight of a pallet would detonate an antitank mine. A 4- by 8-foot pallet loaded with 1,300 pounds of explosives weighs about 1,800 pounds and presents a surface area of about 28 square feet, exerting a unit pressure of 65 pounds per square foot.

c. CONSTRUCTION. The pallet is built of 4- by 6-inch, 2- by 12-inch, and 1-inch lumber and strap iron and cable. It consists of a rugged frame, double floor, and towing cable. It is bound together securely with strap-iron runners fastened with screws. Figure 31.07b gives construction details and bill of material. Figure 31.07c shows top and bottom of the completed pallet.



DETAIL OF IRON PLATE

APPROX TOTAL WEIGHT 500 LB
CAPACITY: SEVENTY-FOUR 18-LB
PACKS C-2
NOTE: SECURE LOAD WITH 4" x 4" GUNWALE TIMBERS

MATERIALS FOR ONE EXPLOSIVE PALLET			
QUANTITY	SIZE	LENGTH	DESIGNATION
13 PCS	1" x 4"	8'	T&G FLOORING
2 PCS	2" x 8"	4'	RAKE (S4S)
9 PCS	2" x 12"	4'	PLANKING (S4S)
2 PCS	3" x 4"	1'	FILLER
2 PCS	3" x 4"	4'	
2 PCS	4" x 6"	8'	SIDES (S4S)
1 EA	5/8" DIA	15'	TOW CABLE (STEEL)
5 EA	5/8"		CABLE CLIPS
4 EA	3/8" DIA	5"	BOLTS
4 EA	1/4" x 2 1/2"	4"	IRON PLATES
3 EA	1/8" x 3"	11'-5"	IRON STRAPS
60 EA	NO 14	2"	WOOD SCREWS
1 1/2 LBS	8d	—	COMMON NAILS
2 1/2 LBS	20d	—	COMMON NAILS
2 PCS	4" x 4"	4'	GUNWALE
2 PCS	4" x 4"	5'-10"	GUNWALE

Figure 31.07b. Construction details and bill of material for pallet.

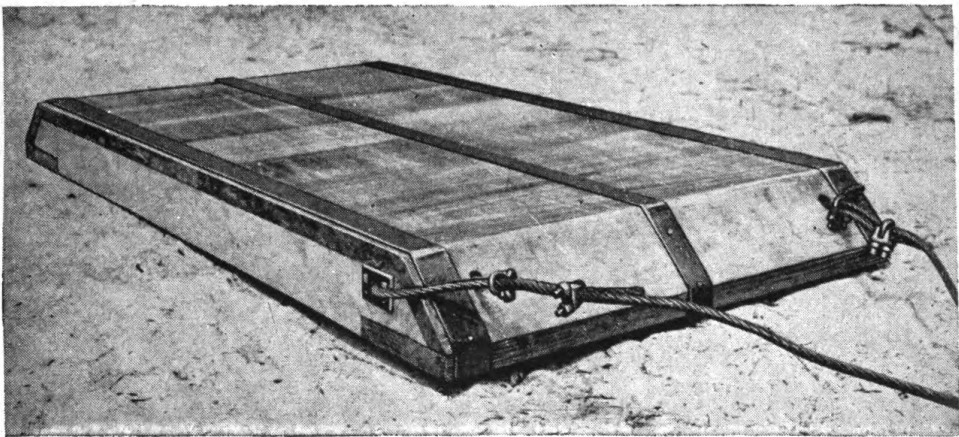
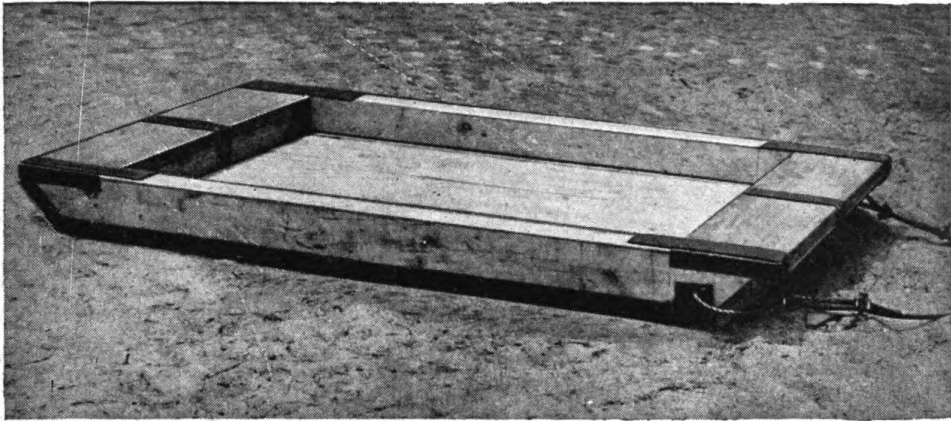


Figure 31.07c. Top and bottom of complete pallet.

31.08. M8 Armored Trailer

a. DESCRIPTION. (1) The M8 armored trailer is a two-wheeled rubber-tired vehicle, armored on sides and back with $\frac{3}{8}$ -inch plate, on the front and covers with $\frac{1}{4}$ -inch plate, and the bottom with $\frac{1}{8}$ -inch plate. It has two hinged covers. Over-all length is $118\frac{1}{4}$ inches, width $88\frac{5}{8}$ inches, and height $52\frac{1}{4}$ inches. It has a 2,100-pound capacity. (See TM 9-791 for additional information.)

(2) A pintle tow hitch on the trailer is fastened by steel pins to the towing lugs at the rear of the armored vehicle. The trailer can be released from inside an advancing armored vehicle by pulling the cable release attached to the hitch. Figure 31.08 shows the M8 trailer towed by an engineer armored vehicle.

b. USE. (1) The trailer is useful for storing and hauling explosives and other materials behind the lines. It is seldom towed behind the engineer armored vehicle during an assault because of its high silhouette, diffi-

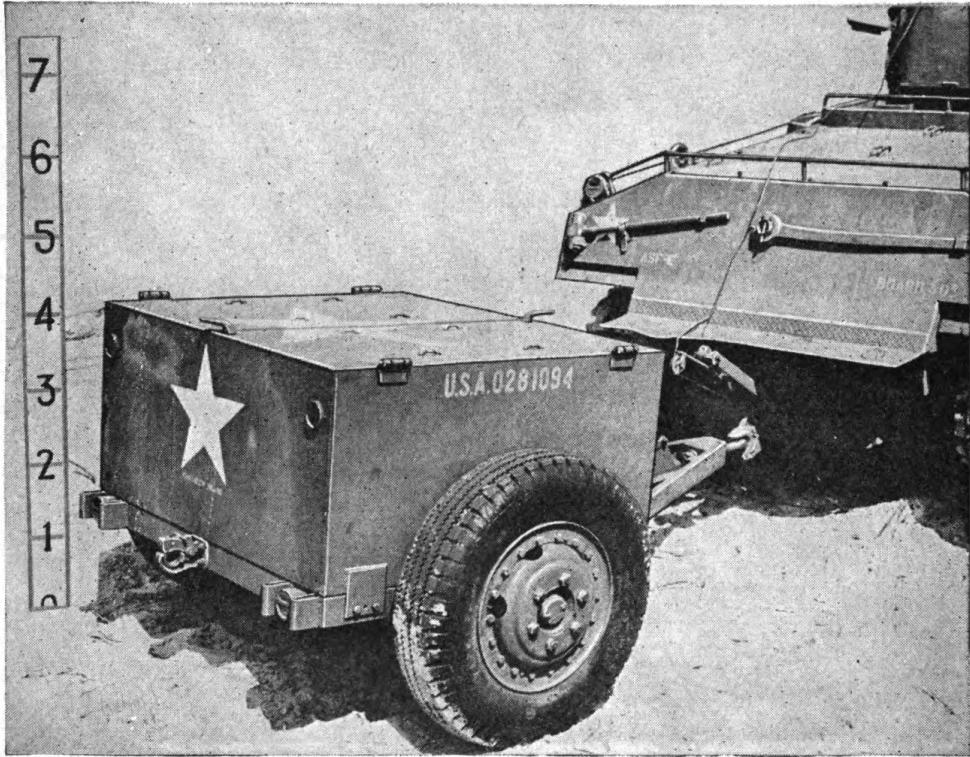


Figure 31.08. M8 armored trailer towed by engineer armored vehicle.

culty in unloading, lack of maneuverability, and the difficulty of backing the vehicle with trailer attached.

(2) The trailer can be easily loaded to capacity with packs of C-2 or tetrytol. It holds only 2,000 pounds of TNT in 50-pound cases.

31.09. 81-MM Mortar

a. DESCRIPTION. The standard 81-mm mortar may be mounted in the armored vehicle turret. Its base plate is cut down to about $6\frac{3}{4}$ by 8 inches, built up flat on the bottom, and bolted to a platform fastened to the rear of the turret basket. A rubber pad between the base plate and platform absorbs part of the recoil when the mortar is fired. A 10- by 10-inch steel plate welded to the roof of the turret holds the elevating-mechanism guide tube in a horizontal position about 12 inches below the turret roof. The two bipod legs hang free. The mortar is held in place in the turret by clamps on the guide tube; the spherical projection on the mortar tube rests in one of the seats of the base plate, and the muzzle projects several inches above the left turret-hatch opening. The mortar is mounted so when the armored vehicle is on level ground the elevation can be varied from 65° to 90° . Figure 31.09a shows the 81-mm mortar mounted in an engineer armored vehicle.

b. USE. (1) The 81-mm mortar is used primarily to fire smoke shells



Figure 31.09a. 81-mm mortar mounted in engineer armored vehicle.

at short ranges to screen the movement of the armored vehicle and the personnel working with it when time does not permit calling on supporting weapons for necessary concentrations.

(2) A secondary use of the mortar is for firing HE shells. The vehicle must be halted to obtain enough accuracy to neutralize small targets. Sighting is done through the gunner's periscope. The mortar is traversed by turning the tank turret, and elevated by using the mortar elevating handwheel. It is fired by a man inside the turret dropping a shell down the open tube. The firer exposes only one hand and part of the forearm.

(3) Firing tables published in FT 81-C2 show mortar elevations and ranges for firing from one to four powder increments. To fire the mortar at shorter ranges, all four powder increments are removed before firing. See figure 31.09b for firing chart for WP shells with no increments. When firing the mortar with no increments, ranges as short as 50 yards can be obtained and time of flight is reduced to about 11 seconds.

(4) To close the turret hatch, the clamping collar is loosened, the mortar tube is lowered so the spherical projection rests on the turret-basket floor plates, and the clamping collar is tightened. In changing elevation of the mortar tube, the clamping collar must be loosened. The

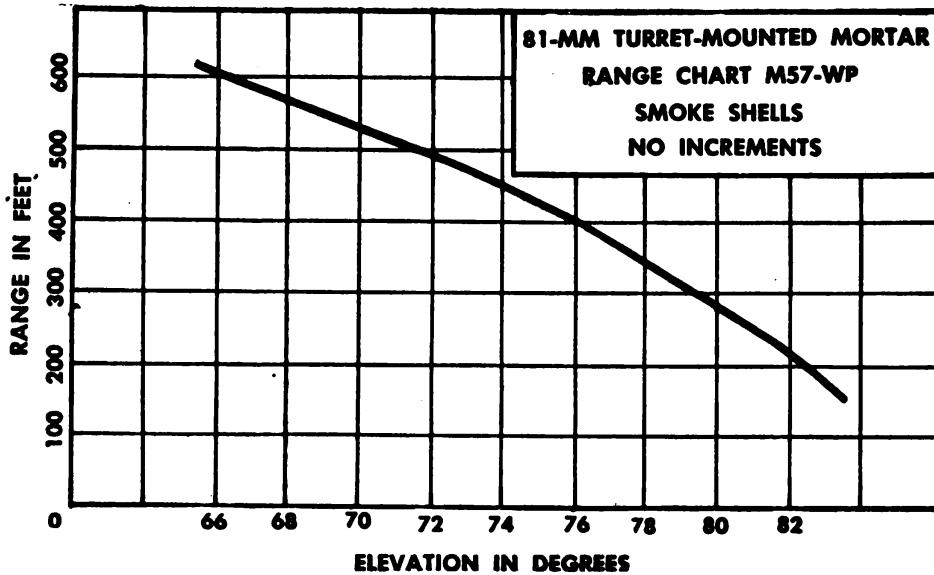
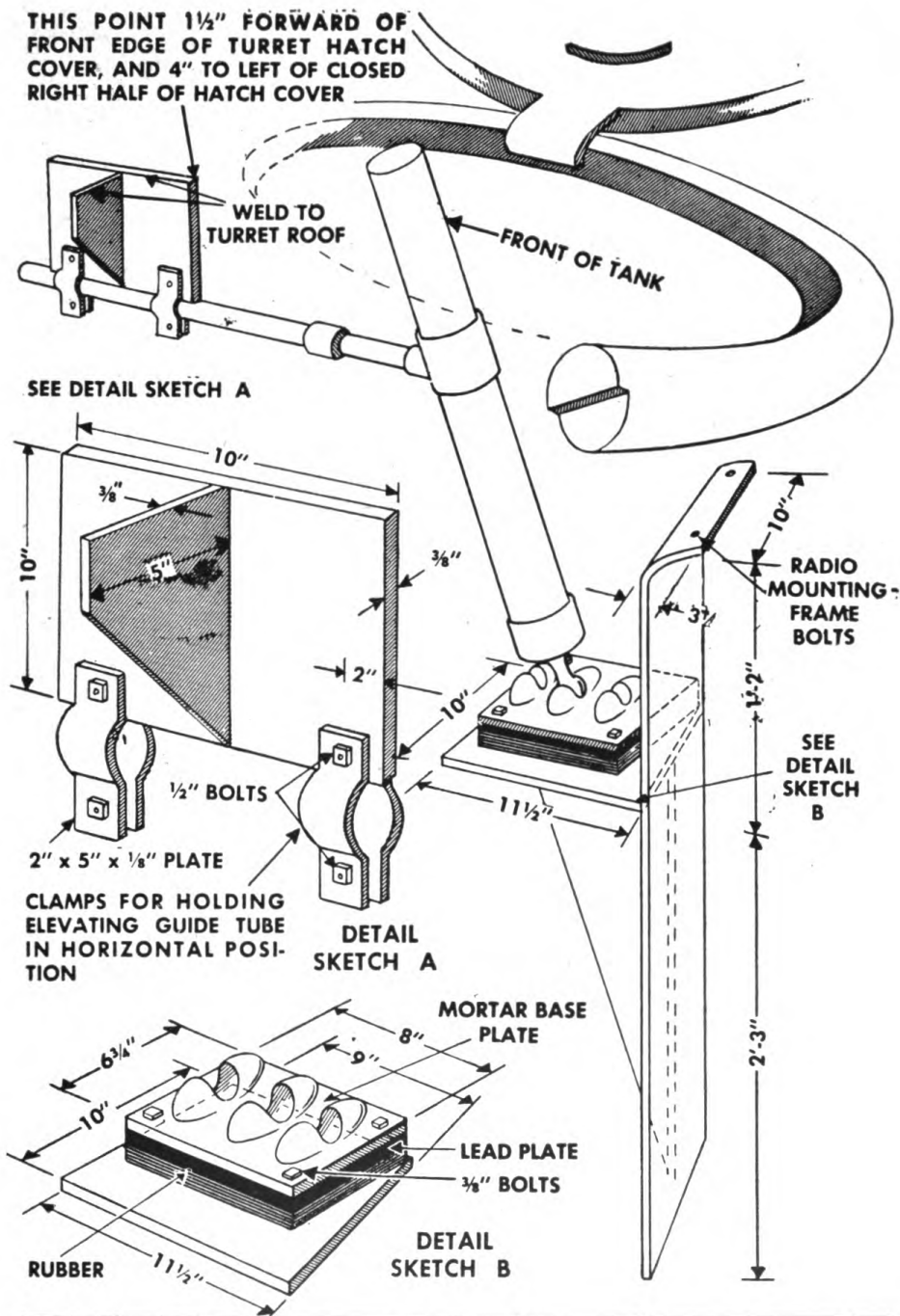


Figure 31.09b. Firing chart for white phosphorus shells fired from turret-mounted 81-mm mortar.

mortar can be taken out of the armored vehicle and mounted on the ground in less than 5 minutes. The mortar cannot be mounted in an armored vehicle equipped with rocket launcher.

c. **MOUNTING BRACKETS.** Two brackets are used to mount the 81-mm mortar in the armored-vehicle turret. Construction details and bill of material are given in figure 31.09c. The brackets are located so the base of the mortar is parallel with the line of sight of the gunner's periscope. The lower bracket is built up of $\frac{3}{8}$ -inch steel plate and is bolted and welded to the rear of the turret basket to support the modified base plate of the mortar. (See fig. 31.09d.) The second bracket is welded to the turret roof in the same plane as the center line of the base plate. The mortar base plate is cut down to $6\frac{3}{4}$ inches by 8 inches. Its under side is filled level by pouring in $\frac{3}{4}$ inch of lead or by welding on beads. The rubber shock absorber is $\frac{3}{4}$ inch thick and may be solid rubber or built up of rubber boat patches or old inner tubes.

d. **CARE AND CLEANING OF 81-MM MORTAR.** For instructions on care of and cleaning the mortar, see FM 23-90.



QUAN	SIZE	MATERIAL	QUAN	SIZE	MATERIAL
1	10" x 10" x $\frac{3}{8}$ "	STEEL PLATE	1	6 $\frac{3}{4}$ " x 8"	MORTAR BASE
1	5" x 10" x $\frac{3}{8}$ "	STEEL PLATE	1	6 $\frac{3}{4}$ " x 8" x $\frac{3}{4}$ "	LEAD PLATE
4	2" x 5" x $\frac{1}{8}$ "	STEEL PLATE	1	6 $\frac{3}{4}$ " x 8" x $\frac{3}{4}$ "	RUBBER
1	10" x 3'-8 $\frac{1}{2}$ " x $\frac{3}{8}$ "	STEEL PLATE	4	$\frac{3}{8}$ " x 3"	BOLTS
1	11 $\frac{1}{2}$ " x 2'-2" x $\frac{3}{8}$ "	STEEL PLATE	4	$\frac{1}{2}$ " x 1"	BOLTS
1	10" x 11 $\frac{1}{2}$ " x $\frac{3}{8}$ "	STEEL PLATE			

Figure 31.09c. Construction details and bill of material for mortar mounting brackets.

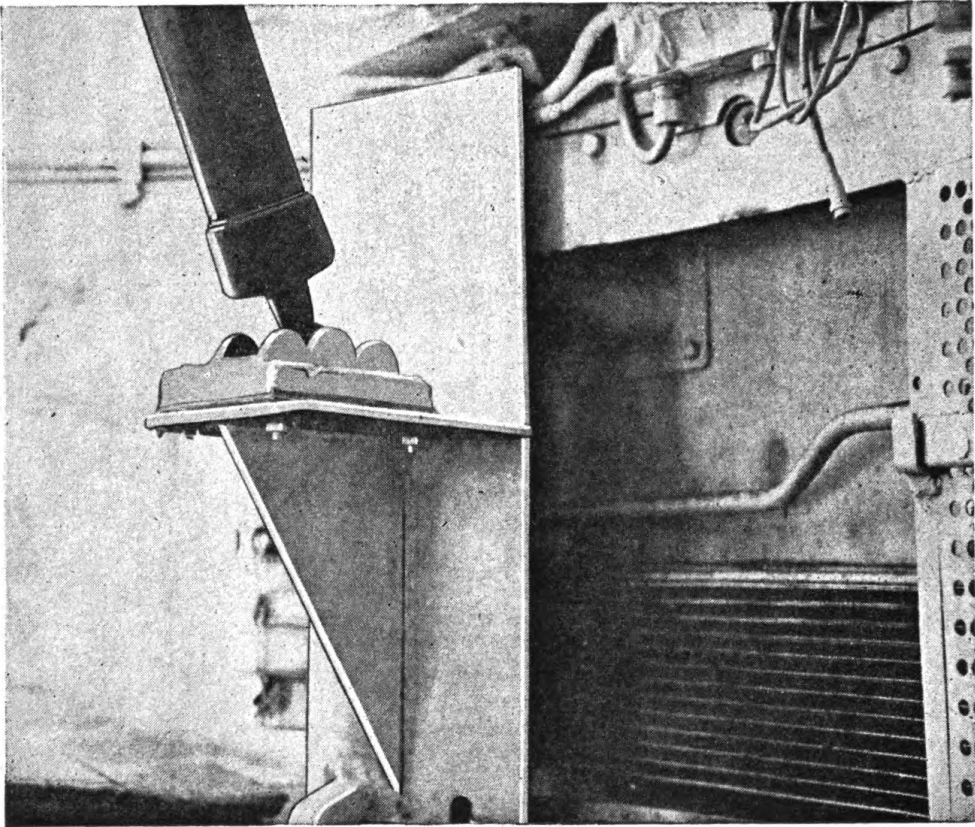


Figure 31.09d. Lower mortar mounting bracket mounted in engineer-armored-vehicle turret.

Section II. ARMORING ENGINEER TRACTORS

32.01. General

This section describes methods for armoring tractors and road graders working in forward areas where operators may be subjected to sniping, strafing, and explosion of land mines.

32.02. Requirements for Protection of Operators

The following are basic requirements for protecting operators of mechanical construction equipment against small-arms fire, grenades, fragmentation bombs, and fragments from land mines:

- a. **ARMOR PLATE.** The minimum thickness of steel plate required is $\frac{1}{2}$ inch, armor plate being preferred to mild steel. Two layers of thinner plate may be used with at least a 3-inch air space between.

b. **MINIMUM OF OPENINGS.** For greatest protection, the size and number of vision and ventilation openings should be kept to a minimum.

(1) *Vision.* (a) A balance between protection and vision must be reached. To meet varying situations, there must be vision slits or ports of several sizes. The required size may be reduced by locating the slit as close to the operator's eyes as practicable.

(b) The glass vision blocks for armored cabs can be installed with a cutting torch and welding apparatus, in any desired location on an armored cab. The operator can see and his eyes are protected against .30 caliber or smaller-arms fire.

(2) *Ventilation.* In hot climates, the steel cabs become unbearably hot unless properly ventilated. Several ports are required to allow circulation of air, and a fan connected to the electrical system of the tractor is desirable. In addition, a shade or canopy should be provided to keep the direct rays of the sun from the steel plates. The canopy should be at least 18 inches above the roof to allow free circulation of air and should extend about 3 feet over the sides.

(3) *Exits.* For quick exit, two doors or openings are needed, since one may become jammed or blocked.

c. **PROTECTION AGAINST GRENADES.** All openings through which hand grenades may be thrown should be covered with expanded metal, wire, mesh, or steel bars. Sloping roofs or gable canopies will prevent grenades lodging and exploding on the roof.

d. **PROTECTION AGAINST BULLET SPLASH.** Bullet splash will enter cracks as narrow as .003 inch. The overlapping construction shown in figures 32.02a and 32.02b will prevent this.

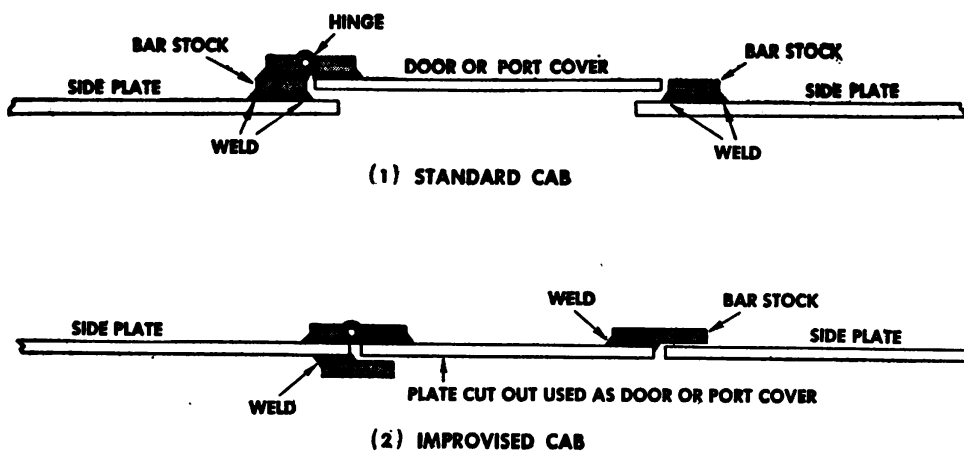


Figure 32.02a. Overlapping construction for doors and ports of armored cabs.

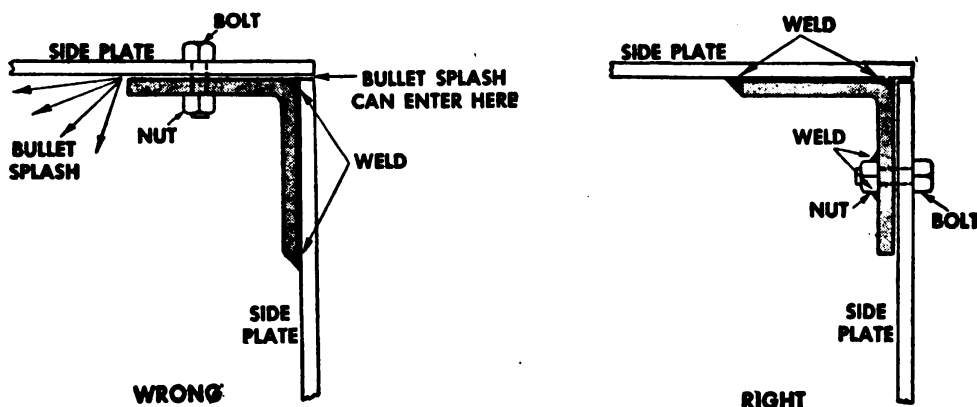


Figure 32.02b. Joint construction for armored cabs.

32.03. Standard Cabs (figs. 32.03a and 32.03b)

Armor-plate cabs are issued for the R4, D4, D6, D7, and D8 Caterpillar tractors, for the modified D7 Caterpillar tractor for beach operation (crane, nonrevolving, tractor-mounting, end, 12,000-pound at 5-foot radius, 14-foot boom), and for the motorized road grader. The grader cab can be installed on the Caterpillar No. 12, Galion No. 101, and Galion No. 101D graders. The armored cabs are class IV stock obtained by requisition through the theater commander. Requisition must state the model desired, by reference to nomenclature and Engineer Supply Catalog stock number listed below:

<i>Nomenclature</i>	<i>Stock No.</i>
Cab, Armored, Tractor, Caterpillar D8 (M1)	78-2285.300.080
Cab, Armored, Tractor, Caterpillar D7 (M2)	78-2285.300.070
Cab, Armored, Tractor, Caterpillar D6 (M3)	78-2285.300.060
Cab, Armored, Tractor, Caterpillar D4 (M4)	78-2285.300.040
Cab, Armored, Tractor, Caterpillar R4 (M5)	78-2285.300.140
Cab, Armored, Grader, M6	78-2285.200.000
Cab, Armored, Tractor, Caterpillar D7, for Beach Operation.	78-2285.300.075

a. DESCRIPTION. Standard armored cabs are similar in general design, weighing from 1,600 to 2,800 pounds, and have the following features:

(1) *Armor.* One-half-inch armor plate is used on all sides and on the roof for all-around protection. Bolt holes, with nuts welded on the inside, are provided so the cab can be shipped "knocked down" and assembled in the field.

(2) *Vision.* (a) The operator sees through a slit on each of the four sides of the cab (figs. 32.03b and 32.03c) or through a larger port at front and back. Since vision through the slits permits only 20 to 50 percent operating efficiency, they are used only when operating under fire. At

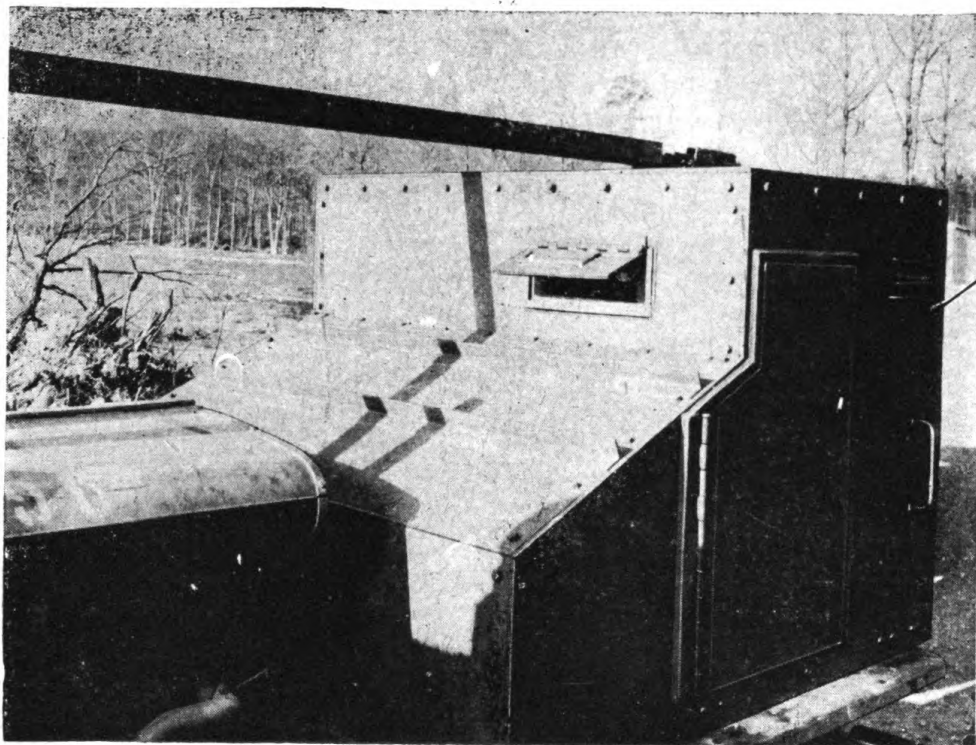


Figure 32.03a. Front view of armored cab of D8 tractor.

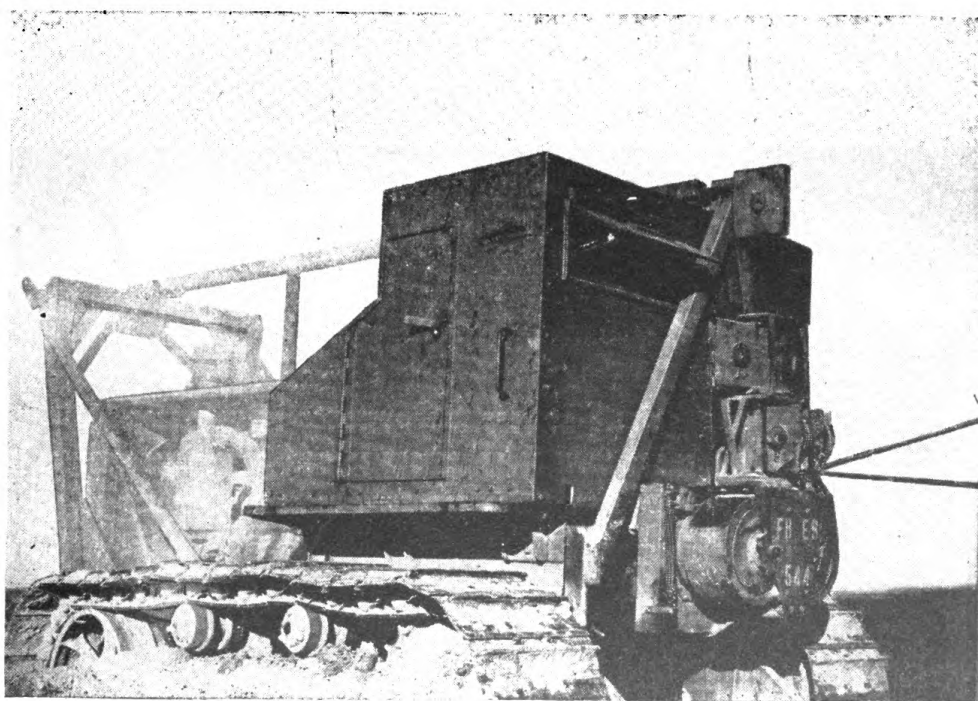


Figure 32.03b. Rear view of armored cab of D8 tractor.

other times the ports are used, permitting 50 to 100 percent operating efficiency. (See fig. 32.03d.)

(b) Hinged plates on front and rear ports are held in various open positions by tightening a thumb screw on a slotted segment. The slits are closed by loosening two screws which permit a small plate to drop over the opening.

(c) The grader cab, new models of the D6, D7, and D8 tractor cabs,

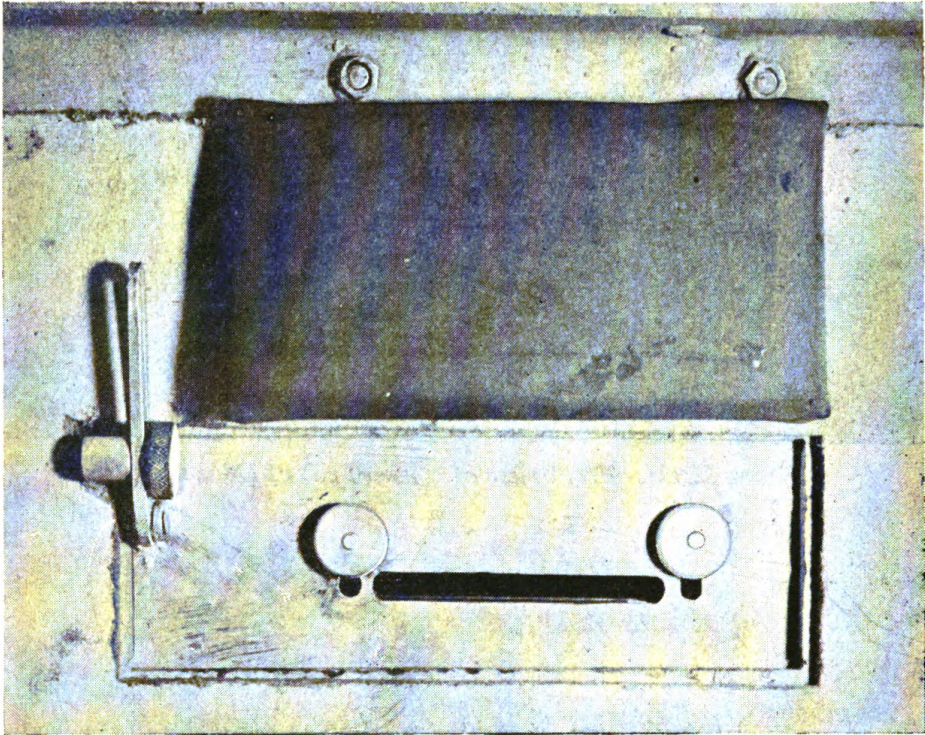


Figure 32.03c. Interior of armored cab, D8 tractor, with vision port closed and slit open.



Figure 32.03d. View through front vision port of armored cab, D8 tractor.

and the beach-tractor cab have a second front port on the right side identical to the left front port. All new models of armored cabs have vision slits fitted with bulletproof glass.

(d) Cab interiors are painted white to reflect enough light so the operator can see the controls and gauges.

(3) *Ventilation.* (a) A ventilator, protected against grenades and small-arms fire, is mounted in the right rear corner of the roof. Air is drawn through the ventilator by a fan connected to the electrical system of tractor or grader. The vision slits and ports provide the necessary air outlets. For further ventilation, when there is no immediate danger, the operator may open the doors 2 or 3 inches and fasten them with the door stops.

(b) The canopy (par. 32.02b(2)) is not issued, but a gable canopy can be constructed from the boxes in which the cab is packed.

(4) *Exits.* Two doors, one on each side of the cab, as well as the vision-port covers, overlap the side plates. Bar stock is welded around the sides to cover the cracks and prevent bullet splash entering the cab. (See fig. 32.02a.)

b. ASSEMBLY. The armored cabs are shipped with complete assembly instructions.

32.04. Improvised Cabs

When improvising protection for operators of tractors and other engineer equipment, basic requirements listed in paragraph 32.02 should be considered. Wrecked tanks, landing barges, and other equipment are sources of steel plate.

a. GENERAL CONSTRUCTION. A combination of bolted and welded construction is desirable. To prevent damage from bullet splash, make joints as shown in figure 32.02b. Notice that the nuts are welded to the angle iron. Then, if the head of the bolt is sheared off by a bullet, the nut and sheared bolt will not ricochet around inside the cab.

b. *Doors and ports.* A method of constructing doors and ports of improvised cabs is shown in (2), figure 32.02a. The piece cut out to make the opening can be used as the door or port cover. A simpler method of making a vision port is to cut around three sides with a torch, heat the upper edge, and bend the plate outward to the desired angle. This type port cannot be closed and must be covered by wire mesh or expanded metal. (See fig. 32.04a.)

c. EXPEDIENT PROTECTION. When the necessary tools, equipment, and steel plates are not available, protection may be limited to designs similar to those shown in figures 32.04b and 32.04c.

d. PLYWOOD ROOFS. Use of the plywood roof (fig. 32.04b) is advantageous even though it will not stop fragments or bullets. The covering prevents hand grenades from being thrown into the cab and also prevents

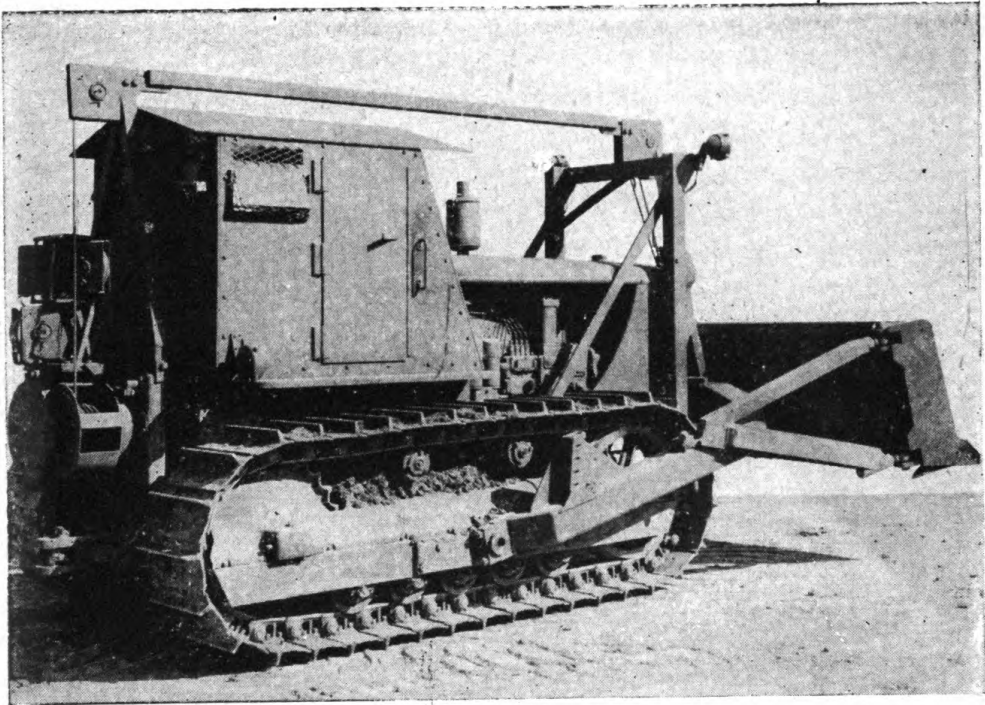


Figure 32.04a. Armored cab with improvised vision port covered with expanded metal.

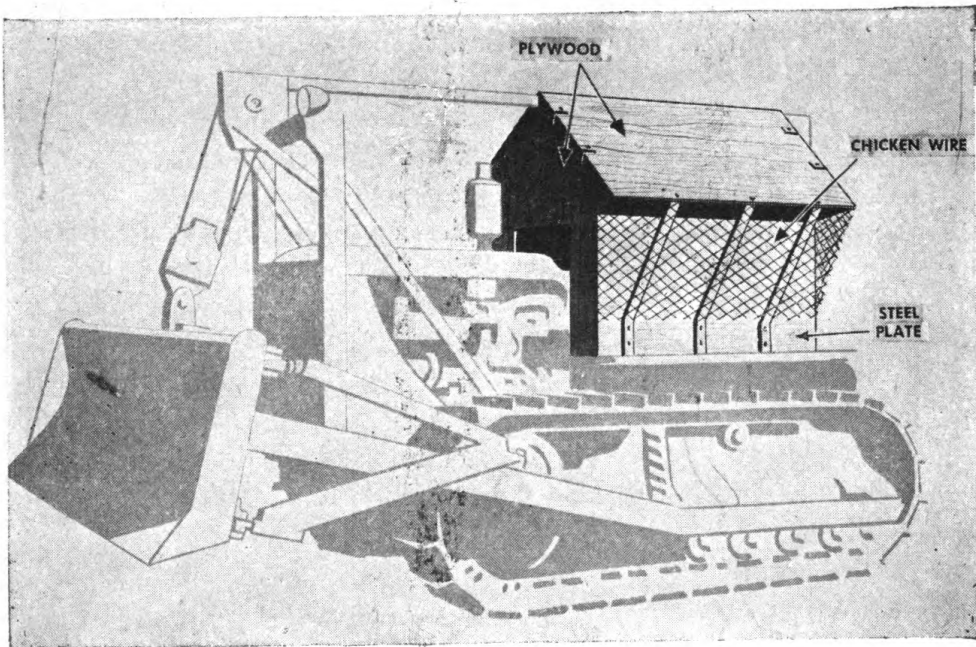


Figure 32.04b. Improvised cab used in Southwest Pacific.

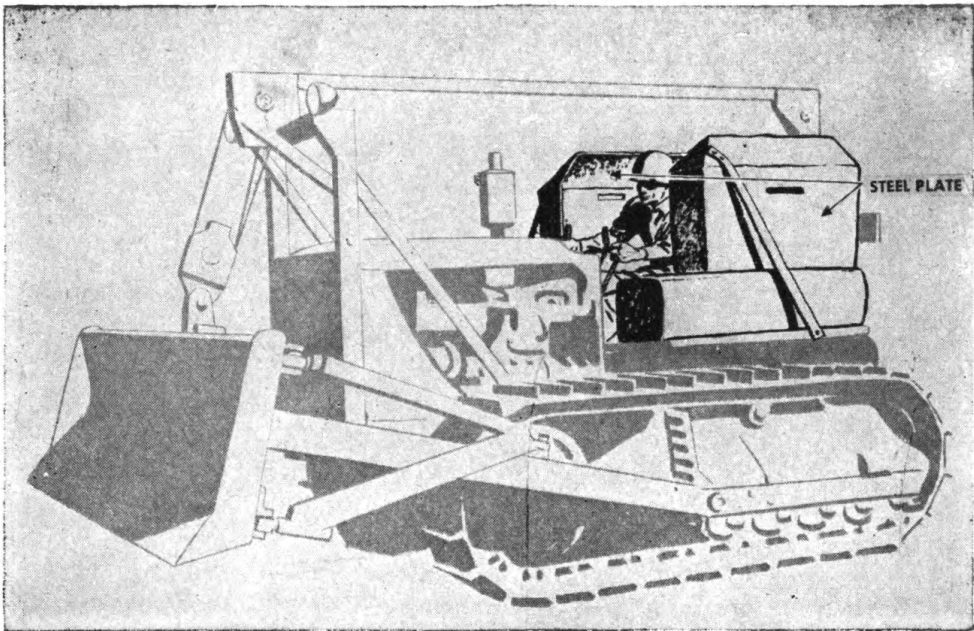


Figure 32.04c. Improvised protection used in Southwest Pacific.

a sniper aiming directly at the hidden operator. Notice chicken wire is used to shield all openings against grenades.

32.05. Protection of Equipment

Steel plates mounted on both sides of the engine greatly reduce its vulnerability to small-arms fire and flying fragments. However, such protection is not always practicable, because the additional weight reduces the operating efficiency of the tractor or other equipment. This is especially true of the lighter tractors such as the D4 and R4.

Section III. TANK BULLDOZER

33.01. General

a. The tank bulldozer is a medium tank with a modified D8 bulldozer blade mounted on its front (fig. 33.01), and is used for assault of obstacles, reducing bunkers, and emergency engineer construction. The blade and parts needed for field installation are contained in an issued kit. The blade fits U. S. M4, M4A1, M4A2, M4A3, and M4A4 medium tanks.

b. The tank bulldozer is substantially equivalent in performance to the D8 tractor dozer. The blade does not reduce the fire power of the tank except on early M4 series models, from which the caliber .30 hull machine gun must be removed.

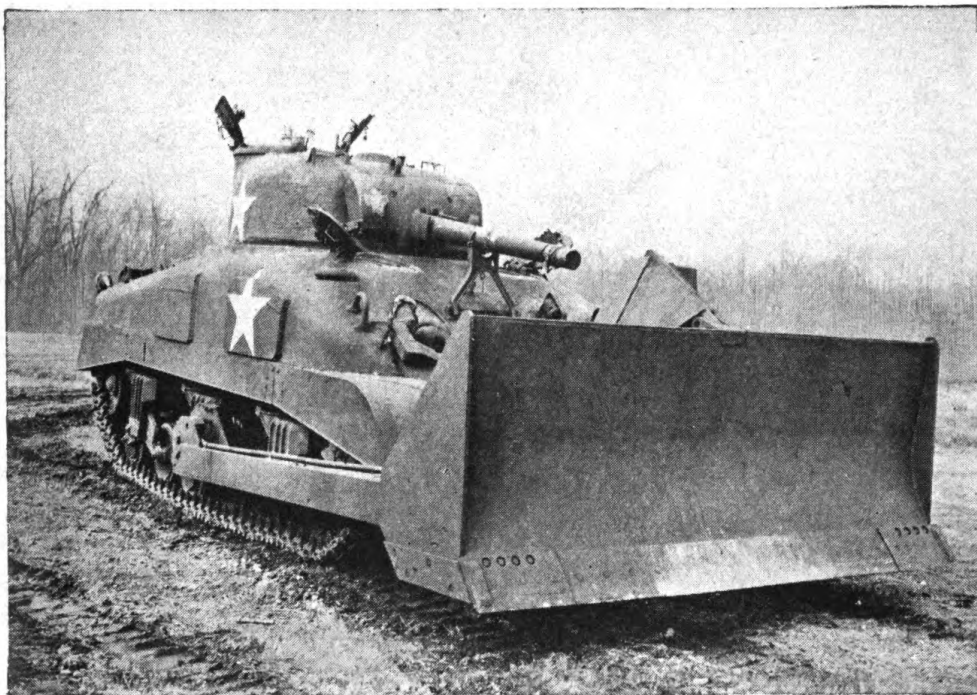


Figure 33.01. Medium tank bulldozer, front view.

33.02. Physical Characteristics

a. WEIGHT AND SIZE. The bulldozer-blade assembly with all its parts weighs 7,050 pounds. The length of a tank with blade attached is 24 feet 7 inches. Over-all width is 10 feet 4 inches. Height of blade and mold-board is 3 feet 10½ inches. A tank bulldozer can cross a Bailey bridge or enter landing craft such as LST's or LCT (5's) without difficulty. (See fig. 33.02a.) It cannot enter LCM's. The weight of the blade does not adversely affect tank balance.

b. AIR SHIPMENT. The blade cannot be shipped by air transport without cutting the main steel frame. The best cutting place, from the design standpoint, is marked on each side of the main frame. (See fig. 33.02b.) The frame is rewelded before use. Two C-47's are required for air transport of the blade and frame, which weighs 5,490 pounds.

33.03. Uses

The tank bulldozer meets any requirement for bulldozer power, tank fire power, and personnel protection. A number of uses either in assault work or for normal dozer tasks behind the lines are listed below. The dozer is not ideal for these tasks but is satisfactory when used to—

a. Fill antitank ditches and road craters.

b. Build sand or earth ramps over antitank walls or other obstacles such as dragon's teeth which are firmly embedded in the ground.



Figure 33.02a. Medium tank bulldozer on Bailey bridge.

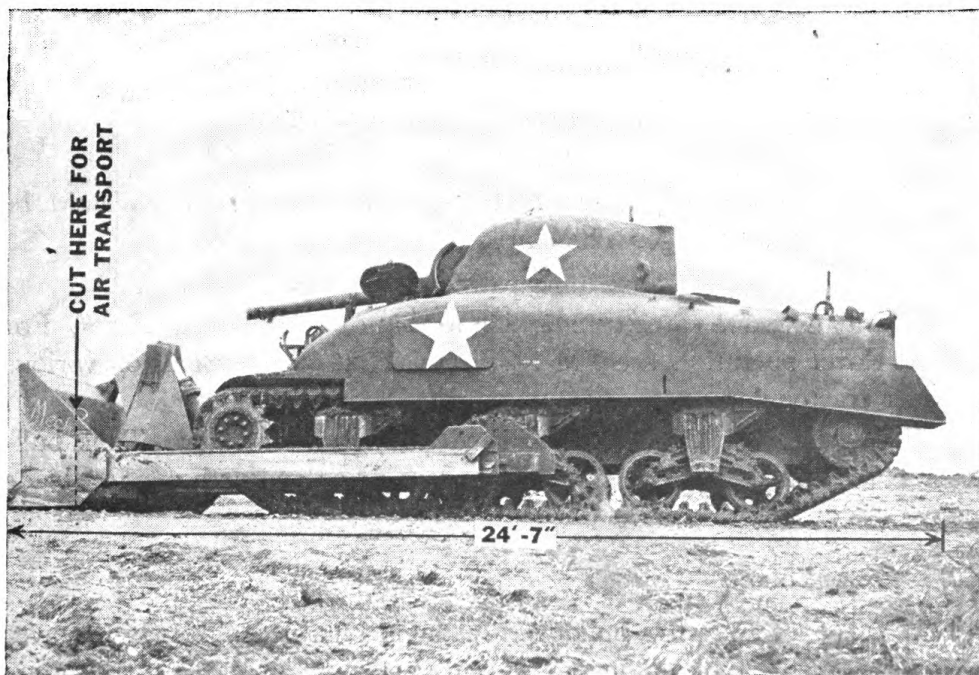


Figure 33.02b. Medium tank bulldozer, profile view

- c.* Push aside concrete and steel antitank obstacles up to 9 tons in weight, such as cubes, coffins, eggs, cylinders, and tetrahedrons.
- d.* Push aside or break off steel rails or structural-steel shapes embedded in shallow water or on shore.
- e.* Rip out barbed-wire entanglements or build earth ramps over them.
- f.* Build and improve vehicle routes on beaches, in jungles, or on more normal terrain.
- g.* Rip apart log pillboxes or cover up their embrasures.
- h.* Push aside disabled vehicles, abatis, debris, and other obstructions on roads or other vehicle routes.
- i.* Push small beached landing craft into deeper water.
- j.* Clear areas of jungle growth or other vegetation.
- k.* Kill or cover up enemy personnel in fox holes.
- l.* Uproot or fire antipersonnel mines.
- m.* Uproot antitank mines for short distances (15 to 20 feet).
- n.* Cut down embankments for temporary vehicle crossings over shallow streams.
- o.* Place explosive charges (Doozit) mounted on the dozer blade for demolition of antitank walls.
- p.* Tow and push fascines into antitank ditches.
- q.* Dig in armored vehicles.
- r.* Construct antitank ditches.
- s.* Perform other excavation or cut-and-fill work.
- t.* Fight ammunition-dump and other fires.

33.04. Technique of Use

The tank bulldozer has three fundamental strengths which should be used to the best advantage. These are:

- a.* Fire power of the tank, unimpaired by the bulldozer blade.
- b.* Ability to move earth comparable to that of a D8 tractor dozer. For detailed dozer operation, see TM 5-252 and Technical Manuals on various engineer tractor dozers.
- c.* Great weight which can be utilized through momentum. Tank bulldozer blade can be used as a battering ram or as an earth-moving blade against obstacles.

33.05. Power Source

Power for operating the bulldozer blade is obtained through a power take-off from the tank engine. The power take-off operates an oil pump inside the tank which supplies hydraulic pressure to a jack mounted outside the tank. The jack raises or lowers the bulldozer blade. It is armored to protect it from small-arms fire.

33.06. Quick-release Mechanism

A trip-clamp arrangement holds the main frame to the track mounting brackets installed on the suspension system of the tank, and a pin connects the hydraulic jack to the bulldozer blade. Both the trip-clamps and the pin connection can be released by cable from inside the tank to drop the bulldozer-blade assembly. The tank can then be backed out of the blade. Jettisoning the blade requires about 10 seconds. The pick-up time is about 3 minutes.

33.07. Control System

The blade is raised or lowered by one control system, installed in the tank with dual control levers, so either the tank driver or his assistant can operate it. A forward motion of the control lowers the blade; a rearward motion raises it. The neutral position holds the blade.

33.08. Operation Buttoned Up

Tank bulldozers are now issued with two lucite periscopes, each having a total angle of vision of 110°. With these periscopes, the tank bulldozer may be operated efficiently with all ports, slits, and doors closed. Standard periscopes on early models made operation difficult because of the limited vision.

33.09. Installation, Operation, and Maintenance

a. Any model medium tank of the M4 series (M4, M4A1, M4A2, M4A3, or M4A4) may be used to mount a dozer blade. Five men are best employed, three within the tank and two on outside work. Inside the tank one man is used in the turret, one in the driver's seat, and the third in the assistant driver's seat. A trained five-man crew can install a blade in about 3 hours.

b. Installation, operation, and maintenance instructions are given in TB ENG 9, 23, 41, and TM 5-1310.

Section IV. PASSING BARBED WIRE**34.01. General**

This section describes methods of passing barbed wire other than by use of explosives. The bangalore torpedo and its use against wire entanglements is described in paragraphs 22.01 to 22.03.

34.02. Mats

a. GENERAL. If wire obstacles are not mined, they can be surmounted by unrolling chicken-wire netting, canvas, or similar mats across them. The material used should be about 5 feet wide and about $1\frac{1}{2}$ times as long as the depth of the obstacle. The mats should not be placed close to pickets.

b. SUPPLIES, EQUIPMENT, AND PERSONNEL. Table II lists the various materials used, dimensions and weights of the mats, and personnel required to lay the mats.

c. PROCEDURE. (1) *Chicken wire or canvas.* (a) Wind the material around an open rectangular frame about 5 feet long and 4 feet wide, made of 1- by 3-inch lumber. Two men carry the loaded frame to the point where the path is to be made. One man then places the material over the wire by flopping it end over end and walking on the unfolded material. (See figs. 34.02a, 34.02b, and 34.02c.)

(b) A second method is to place the material as hardware cloth is placed. (See (2) below and figs. 34.02d and 34.02e.)

(2) *Hardware cloth.* To place hardware cloth (table II), wire two lengths together with a 6-inch overlap, increasing the width to 66 inches. When using it to cross barbed wire, roll it up on a pole so the ends of the pole extend 6 inches beyond the mesh. A roll 40 feet long can be carried by two men. Both men stand on the free end of the roll to hold it down and toss the roll over the entanglement. They then walk over the unrolled portion, pick up the roll, and throw it over the barbed wire yet to be bridged. The roll has a tendency to catch on the barbs of the wire, making unrolling more difficult. (See fig. 34.02f.)

(3) *Cyclone fence.* This fence is heavier than chicken wire or canvas and requires three men to place a 40-foot roll. Wind a 6-foot width on a pole and place it similarly to hardware cloth. (See fig. 34.02g.)

(4) *Galvanized mesh.* This wire is placed the same way as the cyclone fence, but because it is comparatively light, one man can easily carry a 30-foot roll. However, it is more elastic and, therefore, is more difficult to unroll and throw. The mesh also catches easily on the barbs of the fence. (See fig. 34.02h.)

(5) *Light bar-and-rod landing mat.* Three sections loosely connected end-to-end with heavy wire form a mat 3 feet wide and 36 feet long. The sections are folded over each other and carried to the obstacle. Four men are required to carry and unfold the section. It makes an almost rigid path and foot troops can cross it much faster than chicken wire. However, it is heavy, weighing 5.7 pounds per linear foot as compared to 1.5 pounds for chicken wire.

Note. The standard connectors should be cut off when using bar-and-rod landing mat for crossing obstacles. (See fig. 34.02i.)

Table II. Wire-crossing materials

Material	Length (feet)	Width (inches)	Weight (pounds)	Pounds per foot	Men needed to place	Time to place over barbed- wire fence 28 feet deep (seconds)	Time for 12 men to cross (seconds)
Chicken wire, small-mesh (36-inch- wide roll)	40	58	59	1.48	1 or 2	34	30
Canvas	40	48	58	1.45	1 or 2	28	24
Hardware cloth (1/4-inch mesh, 36- inch-wide roll)	40	66	75	1.88	2	51	26
Galvanized mesh (No. 16 gauge, 2-inch mesh)	40	48	21	.53	1	30	30
Cyclone fence (No. 11 gauge)	40	72	103	2.58	3	45	28
Light bar-and-rod landing mat (3- by 12-foot sections)	36	36	205	5.77	4	24	23



Figure 34.02a. Framed canvas before placing.



Figure 34.02b. Placing framed canvas.

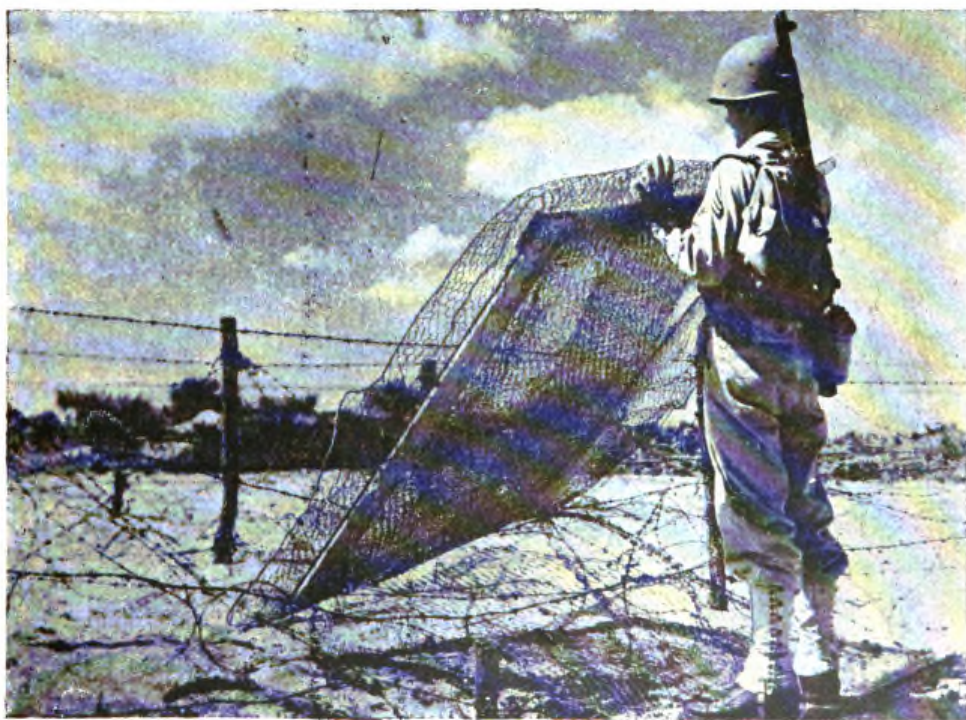


Figure 34.02c. Placing framed chicken wire.

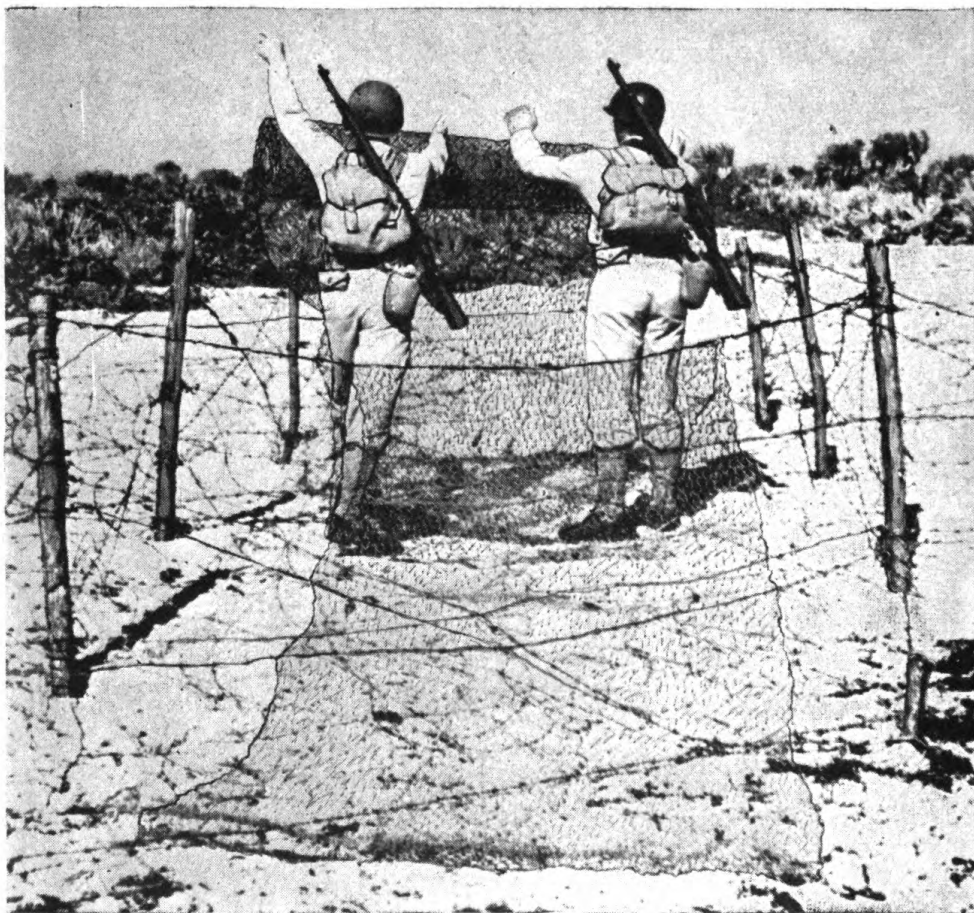


Figure 34.02d. Placing rolled chicken wire.

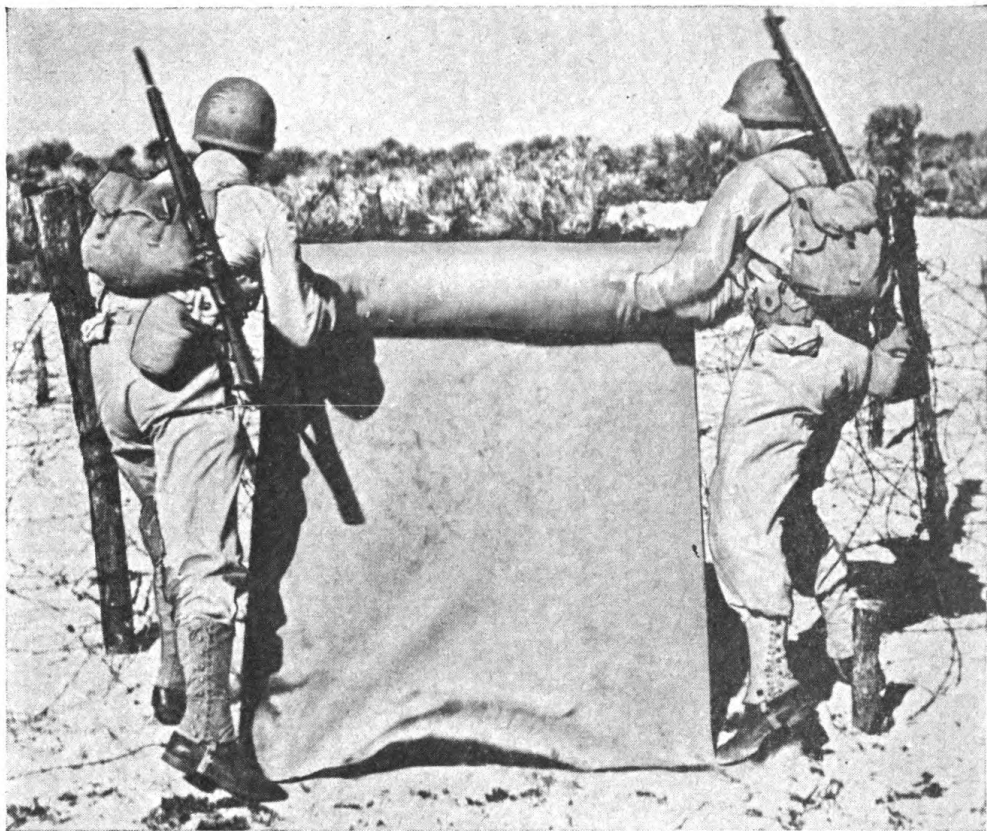


Figure 34.02e. Placing rolled canvas.



Figure 34.02f. Placing hardware cloth.

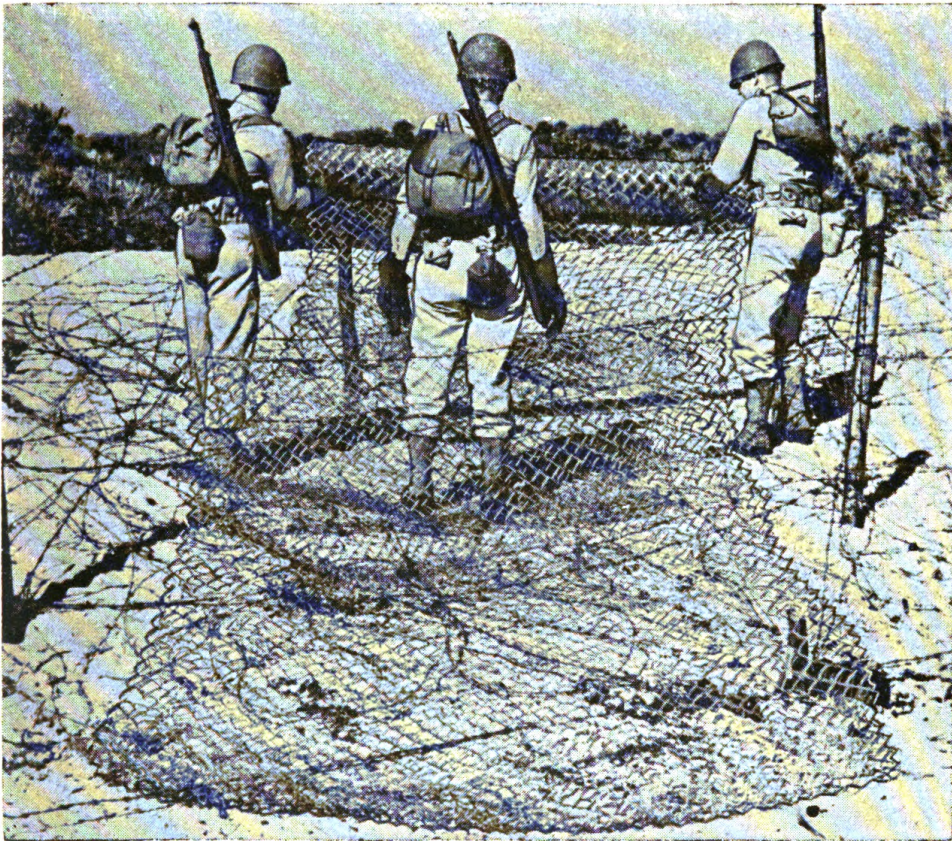


Figure 34.02g. Placing cyclone fence.



Figure 34.02h. Placing galvanized mesh.

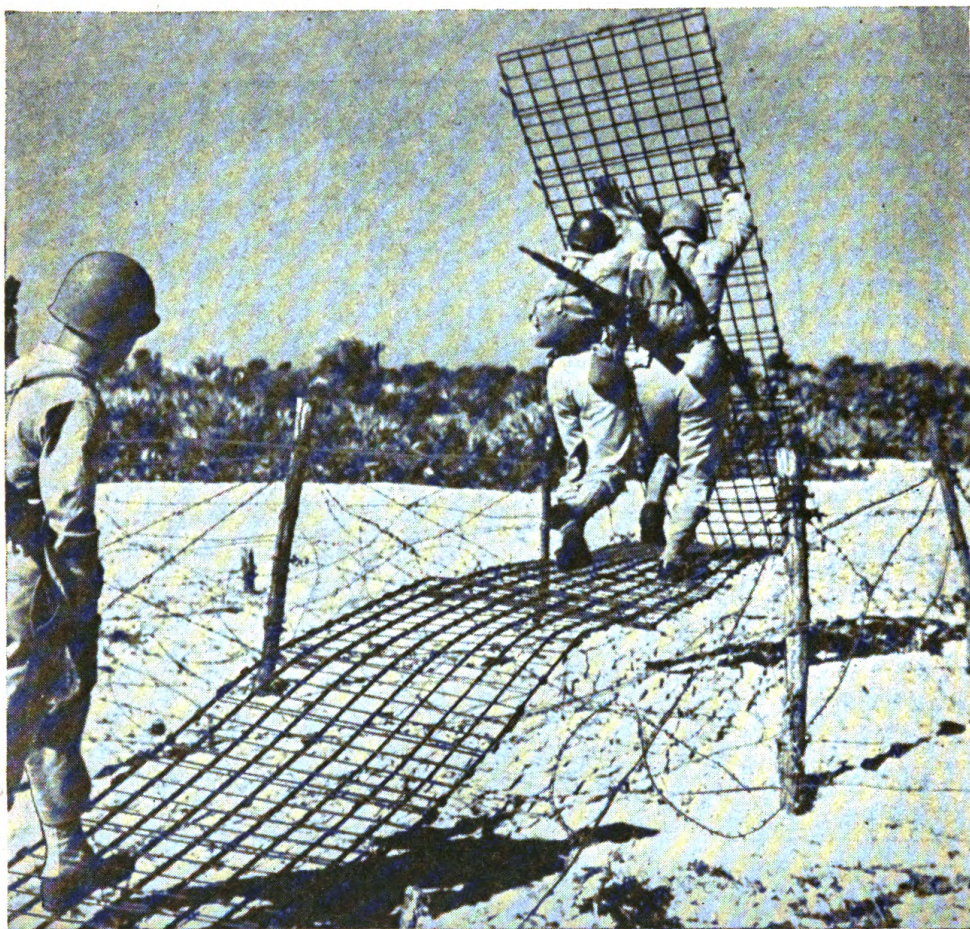


Figure 34.02i. Placing light bar-and-rod landing mat.

34.03. Crawling Under or Through Wire Obstacles

Wire obstacles can be passed by crawling under or through the entanglement, the speed depending on the need for silence and enemy interference. Trained men can crawl through a 40-foot entanglement full of concertinas and high wires on both sides in about 4 minutes. (See FM 21-75 for wire-crossing technique.)

34.04. Cutting Wire

Issue wire cutters may be used to cut a path through a deep entanglement, but this takes considerable time. One man can cut a 3-foot path through a 40-foot fence made of concertinas and high wire in about 4 minutes. Wire cutters should be carried when placing chicken wire or canvas rolls to cut occasional high wires.

34.05. Bridging with Human Body

When other methods are not practical, shallow wire entanglements can be crossed quickly by making a "human" bridge over the wire. The first men in the crossing party throw themselves on the wire and the men following run over them. High or taut wires must be cut before using this method.

34.06. Vehicles

a. CRUSHING WITH TANKS. In an assault, tanks can be used to crush wire entanglements; however, the wire is likely to become snarled in the tank tracks.

b. CLEARING SECTIONS OF WIRE. In the latter phases of a breaching operation, entire sections of wire entanglements can be removed with a rope or cable attached to tanks or trucks or with the winch cable on half-tracks or trucks. Sections of wire may also be removed by dragging a length of wire attached to two tanks.

(1) Details of clearing a section of wire, using a 2½-ton truck with winch, are as follows:

(a) Drive truck to the end of the entanglement so it faces down the fence. Unwind cable on winch and place it over center of fence along the section to be removed. Fasten chain on end of cable around middle of a log about 15 or 20 feet long placed on the ground at the far end of the fence section and perpendicular to it. The truck then winds in cable pulling all pickets and wire in one mass.

(b) Using this method, a truck can pull out an entanglement 40 feet deep and 100 feet long in beach sand at the rate of 20 linear feet of fence per minute. When removing fences with pickets firmly embedded in the ground it may be necessary to pass the cable under the wires of the last 10 yards of the fence before attaching the chain to the log. This prevents

the log from riding over the firmly driven pickets. Such fence can be removed at about 5 linear feet per minute.

(2) Shallow entanglements can be cleared readily by driving the truck close to the fence and facing it at right angles. Place the winch cable under all wires of the fence. Bring the cable back over the fence, hook it to the truck, and wind it in. A grapnel attached to a cable may break the wires instead of pulling the fence out and the hooks on the grapnel may bend and lose their grip on the wire.

c. **CLEARING WITH BULLDOZER.** A bulldozer or tank bulldozer can clear wire rapidly by pushing it out with its blade. The bulldozer should start work parallel to a deep fence, gradually turning perpendicular to it, until the wire is bunched in the center, reducing the depth to about 12 feet. The wire can then be pushed into a single pile. To prevent wire from becoming entangled in the tracks and sprockets, the operator should not pile up too much wire at one pass. It is best to have a man on each side of the dozer to remove immediately any wire caught in the tracks. In beach sand, against wooden post fences driven 20 inches in the ground, bulldozers can clear 40-foot-deep entanglements at the rate of 6 linear feet of fence per minute. Steel angle-iron pickets driven into hard ground slow up removal.

Section V. METHODS OF SURMOUNTING WALLS AND DITCHES

35.01. Bridging Ditches

a. **BULLDOZERS.** The bulldozer or tank bulldozer can refill ditches quickly by using standard bulldozer techniques. Hand tools can be used to break down the sides of the obstacles when the earth is not too hard or the revetment too strong. Corduroy, wire or steel netting provides better footing through the ditch for vehicles. An expedient bridge of planking may provide a practical method of crossing a ditch.

b. **STEEL TREADWAYS.** Steel treadways can be used to cross vehicles over antitank ditches quickly. When the ditch is not exposed to direct enemy fire, the treadway truck or truck crane places the treadways over the ditch. In an assault, a tank recovery vehicle, fitted with an expedient adapter pinned to the front towing lugs, places the treadways without exposing personnel. Pending incorporation in TM 5-272, information about this adapter is presented in TB 272-4. Capacities and maximum lengths of steel treadways with normal spacing and using stiffening beams are given below:

Posted capacity ¹	Maximum span length (feet)			
	20 tons	35 tons	45 tons	55 tons
M1 steel treadways (15' long, 33" wide).	53 ²	36 ²	30	27
M2 steel treadways (12' long, 45½" wide).	60 ²	42 ²	36	32

¹ Tentative. Maximum stress 50,000 psi with load 6 inches eccentric.

² To launch spans three treadways long, use counterweight or launch one tread at a time, depending on site conditions. Maximum span lengths given are based on stress. Special launching methods may be required for spans more than three treadways long.

35.02. Surmounting Walls

a. VEHICLES. Walls can be passed by vehicles by building earth ramps with bulldozers or tank bulldozers. Steel treadways can be placed as ramps on walls which are not too high.

b. PERSONNEL. (1) *Scaling drills*. Drills for scaling walls by personnel are given below.

(a) *Six-foot wall*. The average man with combat pack and rifle can scale a 6-foot vertical wall with no assistance.

(b) *Eight-foot wall*. Two men run up to the wall, stand close to it facing each other, and boost other men over as they run up to the wall. The running man steps into the clasped hands of 1 booster, the second booster grabs his other leg, and they both toss him upwards. From covered positions about 25 yards away, 12 men, including the 2 boosters, can clear the wall in 53 seconds. Another method is shown in figures 35.02a and 35.02b.

(c) *Ten-foot wall*. The same methods are used as on the 8-foot wall. Average time per man is about 5 seconds. When all the men except the two have crossed, one man is boosted up by the other. The last man climbs the wall with the aid of a 1-inch rope, knotted near the ends and held or tied on the far side of the wall.

(2) *Scaling walls with stiles*. Low walls can be crossed using light prefabricated wooden stiles, consisting of two 2-foot steps. The stile can be carried by two men and is faster for crossing vertical walls than the boosting method. However, it is not practical when antitank ditches, barbed wire, or other antipersonnel obstacles are in front of the wall or on sloping walls or high walls with an overhang.

(a) *Eight-foot wall*. Two men run up to the wall carrying the stile by rope handles. The rest of the squad run up to the wall at 10-yard intervals, climb the steps, and cross the wall. Crossing time is about 2 seconds per man.

(b) *Ten-foot wall*. The same method is used as described for the 8-foot wall, but the average time is about 3 seconds per man. Crossing



Figure 35.02a. Surmounting wall, first step.



Figure 35.02b. Surmounting wall, second step.

a 10-foot wall with a 4-foot stile is about the same as crossing a 6-foot wall with no assistance.

(3) *Scaling walls with improvised scaling ladder.* An improved 8-foot scaling ladder 18 inches wide, is built of 1- by 4-inch lumber with rungs 15 inches apart, and weighs about 19 pounds. It can be carried easily by one man. With this ladder, 12-foot vertical walls can be surmounted by small groups of men. It is inferior to a ramp, but is easily constructed. (See fig. 35.02c.)



Figure 35.02c. Surmounting wall with scaling ladder.

(4) *Scaling walls with ramps.* A ramp is the fastest way to cross personnel over walls 8 to 12 feet high. Starting from covered positions 40 yards from the wall, a squad can pass such a wall in 30 to 40 seconds. A concrete wall with barbed wire on top can be passed readily by at-

taching a chicken-wire mat to the nose of the ramp, but this increases the crossing time by about 10 seconds.

(a) *Supplies and equipment.* One plywood ramp with chickenwire roll as described below; one pair of wire cutters.

(b) *Organization of party.* One noncommissioned officer and five men.

(c) *Description of ramp.* The improvised ramp, built of $\frac{1}{2}$ -inch plywood, is 16 to 20 feet long and 2 feet wide. It has $1\frac{1}{2}$ - by 20-inch cross-slats on top spaced on 15-inch centers, and three 2- by 4-inch longitudinal stringers on the bottom strengthened by six 1- by 2-inch strips nailed diagonally across these braces. The ramp weighs 100 to 125 pounds. Crossing of wire obstacles on top of the wall is made easier by nailing a roll of chicken wire, $3\frac{1}{2}$ feet wide by 10 feet long, to the top of the ramp. The roll is made more rigid by wiring 1- by 3-inch cross slats to the underside of the roll on 15-inch centers. The rolled wire is tied at each end with a slipknot, until the roll is ready for use. (See figs. 35.02d and 35.02e.)

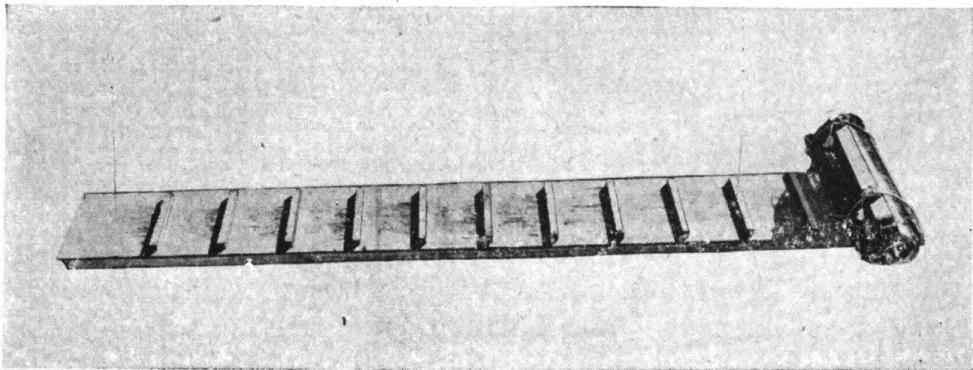


Figure 35.02d. Personnel ramp.

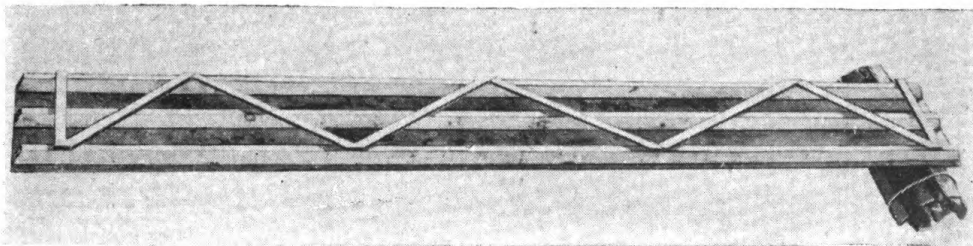


Figure 35.02e. Bottom construction of personnel ramp.

(d) *Crossing procedure.*

1. The noncommissioned officer and five men carry the ramp forward at a run to a position near the wall. The two lead-carriers, assisted by two side carriers, lift the nose and move back from the wall, continuing to push up on the ramp.

The two rear carriers hold the other end on the ground to prevent the ramp from slipping. All six carriers, three on a side, slide the ramp up and forward into final position against the wall.

2. When the ramp is in position, the noncommissioned officer unties the slipknotted cord holding the rolled wire mat, carries the wire roll up the ramp, and tosses it over the barbed-wire fence. He carries wire cutters to cut high, taut barbed wire. Crossing time over an 8-foot wall with two concertina barbed-wire obstacles on its top is about 45 seconds per man, starting from a position 40 yards away. (See figs. 35.02f and 35.02g.)
3. When an antitank ditch or barbed wire is in front of the wall, the ramp may be stood on end and flipped over into position against the wall. For such use, the ramp is carried upside down and bottom end forward. A ditch 15 feet wide in front of an 8-foot wall can be passed with a 20-foot ramp.

Section VI. BODY ARMOR FOR USE IN PASSING OBSTACLES

36.01. General

Flyer's armor is a flexible link steel body covering originally developed to protect airplane crews from antiaircraft fire. Flyer's armor M1 and M4 (fig. 36.01) are suitable for engineer personnel performing certain tasks. The armor gives considerable protection against fragments from hand grenades, antipersonnel and antitank mines, and against pistol fire. It does not protect against rifle fire at close range. In warm climates the armor makes the wearer uncomfortably hot.

36.02. Description

Flyer's armor M1 is a two-piece vest which protects the upper portion of the body. Flyer's armor M4 is an apron which attaches to the lower edge of the front vest. The total weight is 24 pounds, the front vest weighing 7 pounds, the back vest 10½ pounds, and the apron 6½ pounds. The front vest and back vest are fastened together by dot fasteners at each shoulder and by straps at the sides. The apron is attached to the front vest by dot fasteners. A rip cord permits instant removal of the armor in an emergency. Although the vest may be worn alone, the complete M1-M4 combination provides greater protection and better weight balance.



Figure 35.02f. Releasing chicken-wire roll.

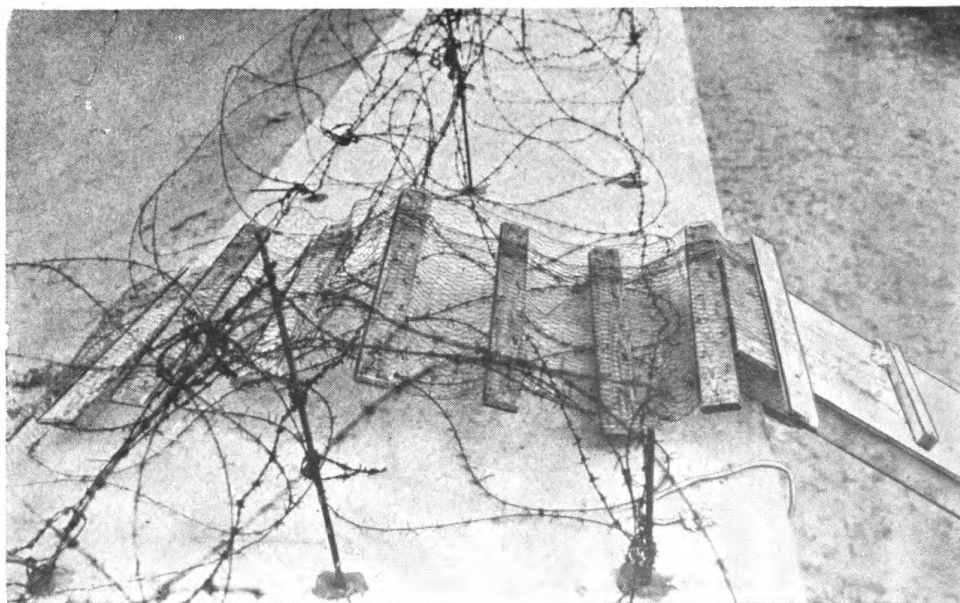


Figure 35.02g. Personnel ramp in position.



Figure 36.01. Flyer's armor M1 and M4, front and side views.

36.03. Employment

The armor is suitable for use in mine clearing (FM 5-31) and the following engineer operations:

a. OPERATING HEAVY EQUIPMENT IN COMBAT ZONES. The armor does not interfere appreciably with operation of engineer heavy equipment.

b. AMPHIBIOUS OPERATIONS. The armor does not handicap wearers in landing-craft operations or assault-boat crossings. Life preservers worn over the armor prevent the armor from dropping off when the rip cord is pulled.

c. REDUCTION OF BUNKERS AND OBSTACLES. The armor can be used satisfactorily in assaulting bunkers and obstacles but has the following disadvantages:

(1) Men are bothered by the apron striking against their legs when running.

(2) The shoulder snaps may become undone when men hit the ground.

(3) The apron may come off when men are advancing by bounds and when creeping or crawling.

CHAPTER 4

PASSAGE OF UNDERWATER AND BEACH OBSTACLES

Section I. GENERAL

41.01. General

The following paragraphs prescribe engineer techniques for passing underwater and beach obstacles likely to be encountered in amphibious operations. The tactical planning and coordination necessary to apply these techniques in a particular operation can be accomplished only with a full knowledge of the special problems of supply, training, and the tactical situation.

41.02. Planning

a. RECONNAISSANCE. Detailed aerial and other reconnaissance normally is carried out over large sections of the coast where a landing is planned. From data thus obtained and from general knowledge of enemy doctrine and technique, an estimate is made of the beach and types of obstacles to be encountered. Tactical planning and training for the obstacle-breaching operation are based on this information.

b. ALLOWANCES FOR CONTINGENCIES. In planning the operation, consideration must be given to the possibility of not landing on the selected beach because of inaccurate navigation or changes in landing locations by higher headquarters. The contingencies of battle and the possible existence of obstacles not located by previous reconnaissance must not be overlooked. Men must be trained in breaching all known types of obstacles and must have extra supplies to care for such contingencies.

c. AIR AND NAVAL SUPPORT. Air and naval bombardment may make partial gaps through some of the obstacles, but such assistance is not considered in planning unless a specific obstacle-breaching mission is assigned to the naval or air forces.

d. FAVORABLE BEACH CHARACTERISTICS. Strategic and tactical considerations may be such that a selected beach in itself is an obstacle. If possible, beaches chosen for the landing should have the following characteristics:

(1) Steep gradient below waterline (1:20) so landing craft do not ground far from the beach and require troops to wade ashore slowly.

(2) Firm sand to allow stable grounding of landing craft and to provide good traction for vehicles. Pebbles or shingle beaches are slippery, mud is sticky, and rocks endanger boats and personnel.

(3) Road net approaching the beach to allow rapid movement of vehicles and supplies away from the beach.

(4) Minimum surf and current so boat handlers can land at proper locations and back off without capsizing boats.

(5) Lack of natural obstructions such as sand bars, reefs, or rocks, and of artificial obstacles.

(6) Maneuver area ashore for action against defenders.

(7) Trees and other vegetation near the beach to provide necessary concealment.

41.03. Operation Phases

Obstacle-breaching operations in a landing are divided into three phases:

a. Assault and passage by personnel of the initial waves to remove enemy small-arms fire from the beach. In this phase, surmounting methods are normally employed.

b. Breaching for the passage of vehicles and large bodies of troops. Destruction methods are normally employed in this phase and speed is essential.

c. Clearing to permit unrestricted use of the beach area for supply and movement. Removal methods are applicable.

Section II. TYPICAL BEACH OBSTACLES

42.01. General

Common obstacles likely to be encountered on beaches above the waterline or entirely or partially submerged, depending on the tides, are covered in paragraphs 13.01 to 13.07 inclusive, and FM 5-15. Additional types of obstacles are noted below.

a. STEEL SCAFFOLDING. Steel scaffolding (fig. 42.01) is effective when located in the water or along the beach.

b. STEEL RAILS IN SEA FLOOR OR CONCRETE. Steel rails are often used in bands of three or more rails deep. They may be embedded in the ground or in blocks of concrete (horned scully) and the blocks placed under water. Rails are a simple, effective, easily placed obstacle.

c. SAND BARS. Sand bars are effective natural obstacles along many beaches.

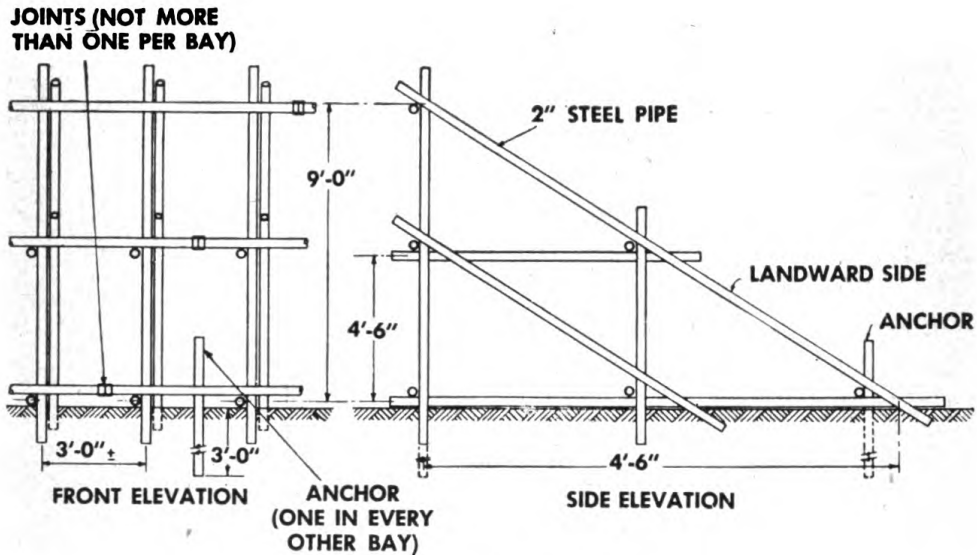


Figure 42.01. Steel scaffolding.

d. **FLOATING OBSTACLES.** Floating obstacles such as booms, steel cables, and nets may be encountered.

42.02. Japanese Obstacles

Because of the shortage of manufactured materials, the Japanese build many obstacles in the Pacific theater with local materials such as rock and logs, and supplement construction with small amounts of concrete, reinforcing rods, precut timber, steel wire, and explosives. Some of the Japanese obstacles encountered in the Pacific theater are described below.

a. **WIRE ENTANGLEMENTS** (fig. 42.02a-42.02e). (1) The Japanese use single-strand barbed-wire fences in belts varying from one to four rows. Double-apron fences and net entanglements have been reported, while movable obstacles include knife rests strung with barbed wire, movable barriers which can be rolled up for transport, and concertina wire. The Japanese do not appear to have ready-made concertinas of the Dannert type.

(2) Staked-down brushwood, sharpened stakes, and even small trees are used as a substitute for, or to supplement, existing wire. A well-defended strip of coast may have three lines of antipersonnel obstacles: barbed wire near the shore, numerous sharp bamboo stakes a short distance inland, and a third row of barbed-wire entanglements. In more developed areas, such as port areas, wire is often fixed on metal bars embedded in the sea wall.

(3) Trip wires may consist simply of plain or barbed strands, pegged into the beach ankle high, but they are frequently encountered as loops and rings pegged down in regular patterns. Such snares and other wire below high-water level effectively hinder troops wading ashore. Another

obstacle consists of spiral springs, resembling bedsprings, laid in regular rows and supporting trip wires. These types of obstacle are unlikely to hinder tanks but may delay infantry.

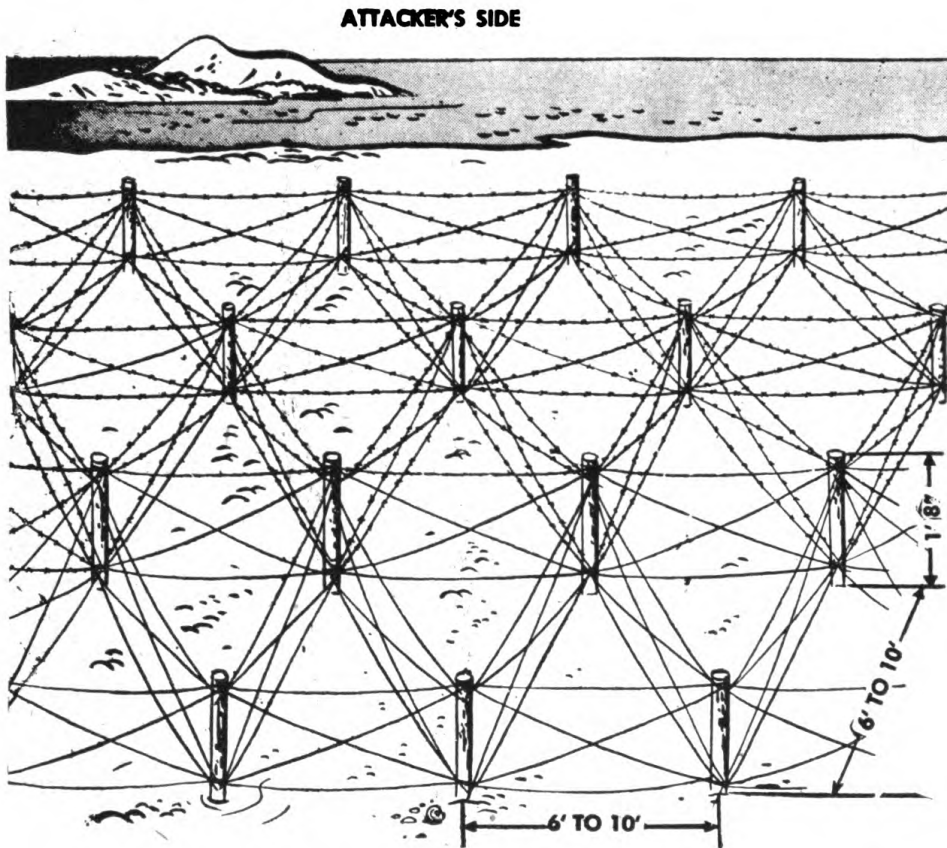


Figure 42.02a. Net entanglements employing both barbed and plain wire.

b. **SMALL CONCRETE OBSTACLES.** (1) *Tetrahedrons.* The Japanese use concrete tetrahedrons as beach obstacles. Use of two or more rows, with the tetrahedrons spaced at 6 to 10 feet center-to-center in each row, is typical.

(2) *Horned scullies.* A typical Japanese horned scully (fig. 42.02f) weighs approximately 1 ton and has three 3-foot 6-inch lengths of 90-pound rails embedded 1 foot 6 inches in the reinforced concrete at a 45° angle. The ends of the rails may be sharpened. Japanese scullies have been used in conjunction with beach mines and barbed wire.

(3) *Frame type obstacle* (fig. 42.02g). This design is a compromise between economy of construction, ease of placing, and obstruction value. The bottoms of the frames are ballasted with rocks, and adjoining frames may be coupled together with chains or steel wire rope.

(4) *Posts.* Concrete posts may be placed by first blowing holes in a coral reef or rock base; then the posts are concreted in when the sea is

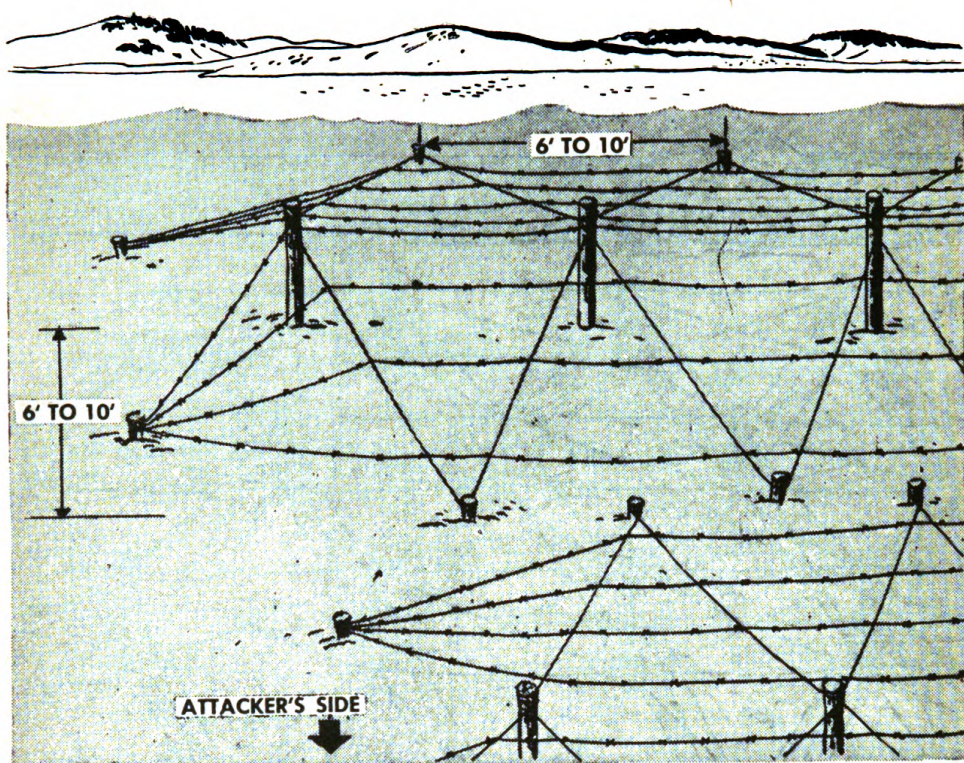


Figure 42.02b. Double-apron fence.

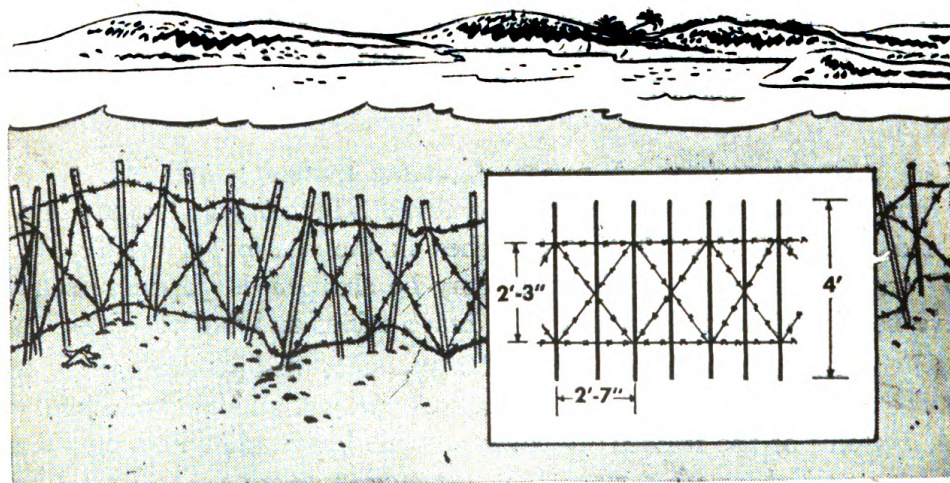


Figure 42.02c. Movable barrier.

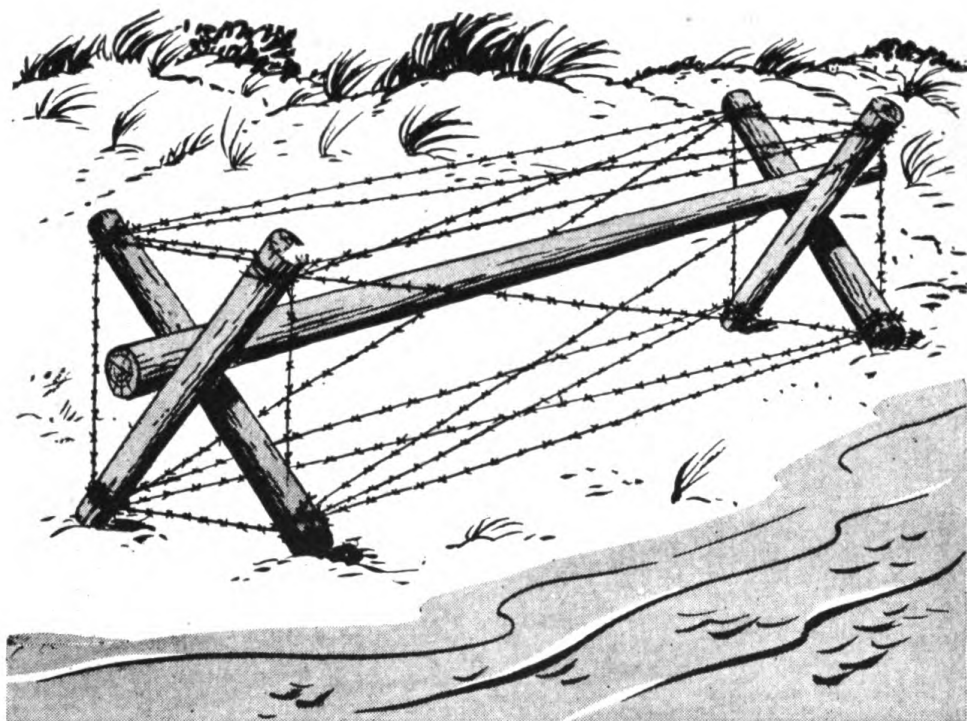


Figure 42.02d. Knife rest strung with barbed wire.

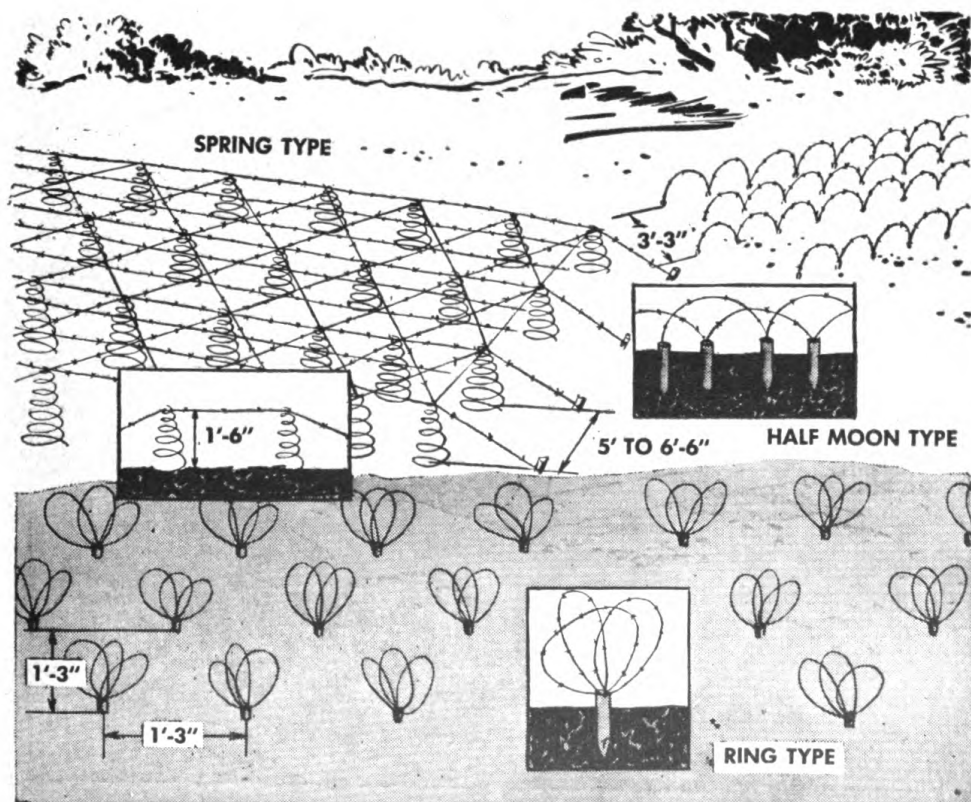


Figure 42.02e. Snares.

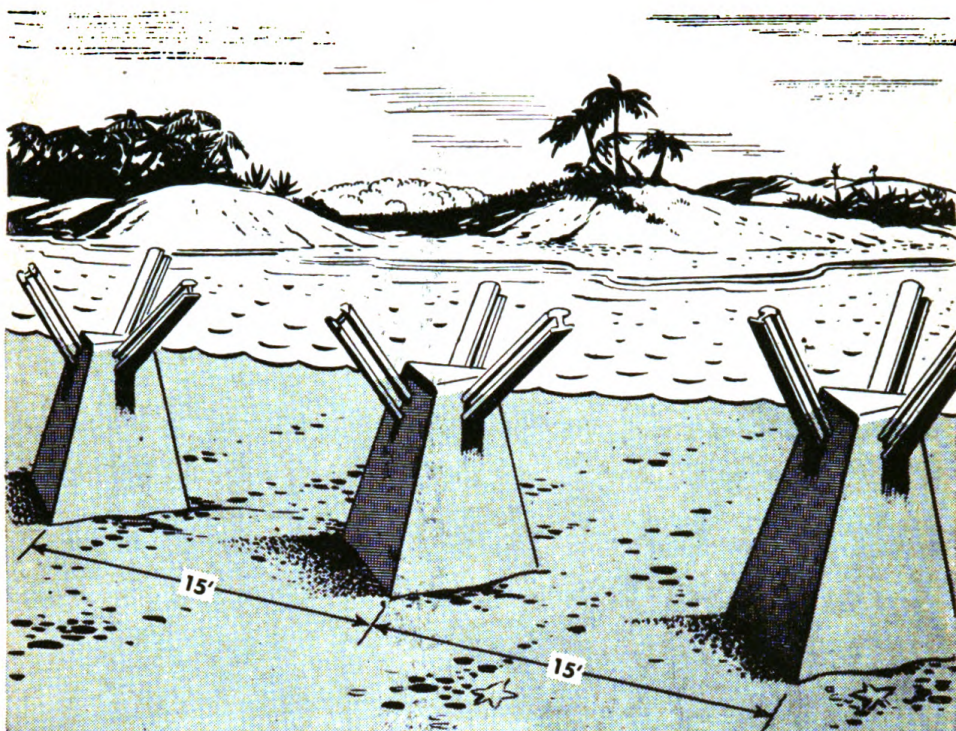


Figure 42.02f. Japanese horned scullies.

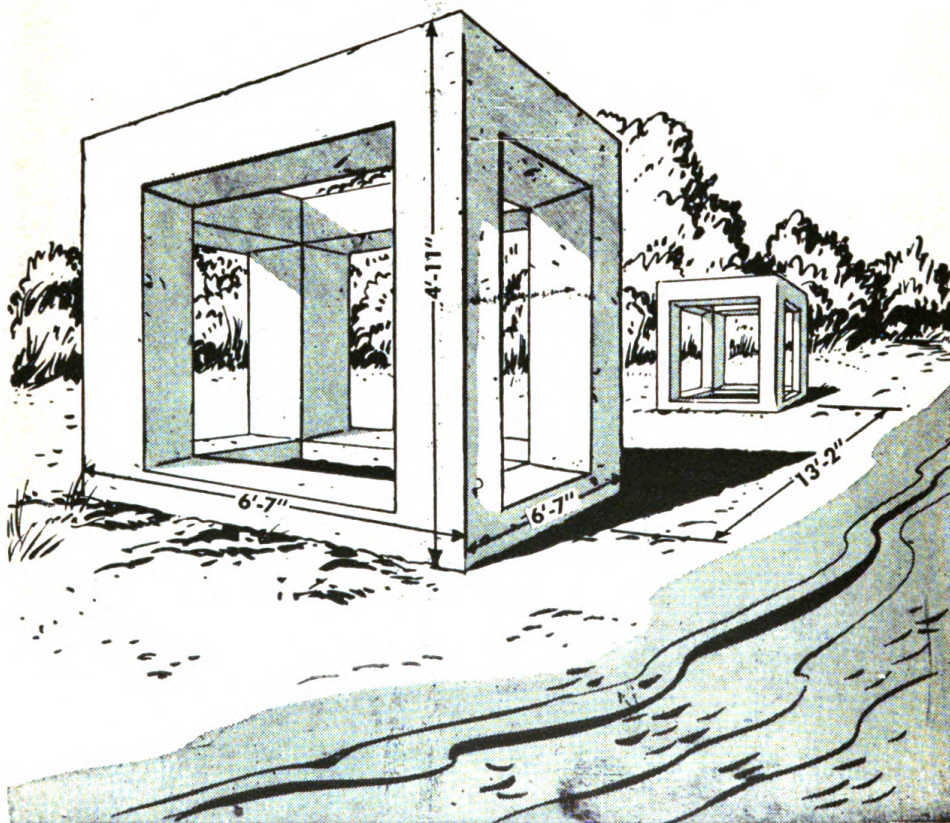


Figure 42.02g. Frame type beach obstacle.

calm. Posts are placed vertically or inclined seaward. They are sometimes placed in several rows, the rows 5 feet apart and the posts in each row 8 to 10 feet apart.

c. WALLS. The Japanese also use backfilled concrete, stump, or log walls. Typical walls with log facing are shown in figure 42.02h. Japanese stump walls are built with tree stumps from 2 to 8 feet long, the root ends facing the attack.

d. WOODEN OBSTACLES. (1) *Log cribs*. Rock-filled rectangular log cribs 6 to 10 feet long, 3 to 4 feet wide, and 6 to 7 feet high have been found underwater and above the water's edge on beaches. (See fig. 42.02i.) Rock-filled triangular pillars are a variation of the crib type obstacle. (See fig. 42.02j.) Log cribs may be connected with barbed wire, cables, or steel wire rope.

(2) *Tetrahedron* (fig. 42.02k). Most of the tetrahedrons placed by the Japanese appear to be made of wood although some are steel. The wooden tetrahedrons are constructed of logs or poles, braced by cross members at the base and weighted with rocks or anchored with ends buried in the sand. They are spaced at 15- to 30-foot intervals and often are incorporated in wire fences.

(3) *Log scaffolding*. Figure 42.02l illustrates typical Japanese log scaffolding.

(4) *Posts*. Wooden posts are driven into sand or concreted into reefs. The posts may be diagonally braced as shown in figure 42.02m. Barbed wire may be strung between posts to impede assault troops.

(5) *Knife rests* (figs. 42.02d and 42.02n). Knife rests are constructed of logs or poles and sometimes are strung with barbed wire. They are usually set up in shallow water 6 to 10 feet apart.

e. ROCK OBSTACLES. (1) *Rock mounds* (fig. 42.02o). Mounds, usually built of coral, are approximately 3 feet high and 10 to 12 feet square and are staggered at 10- to 15-foot intervals on the outer edges of reefs. Such mounds may contain mines.

(2) *Rock walls* (fig. 42.02p). Rock walls approximately 4 feet high and from 3 to 4 feet wide are built in sections as well as in continuous lines. In some instances, they may be topped with wire.

(3) *Rock-filled mesh wire*. The Japanese use rolls of rock-filled mesh wire arranged in a line along the outer edge of a reef.

f. STEEL OBSTACLES. No all-steel obstacles have been noted to date. Occasionally the Japanese use small quantities of steel rail in conjunction with concrete and wooden obstacles.

g. DITCHES. Japanese doctrine specifies that a ditch should be 10 feet wide by 6½ feet deep to stop medium tanks.

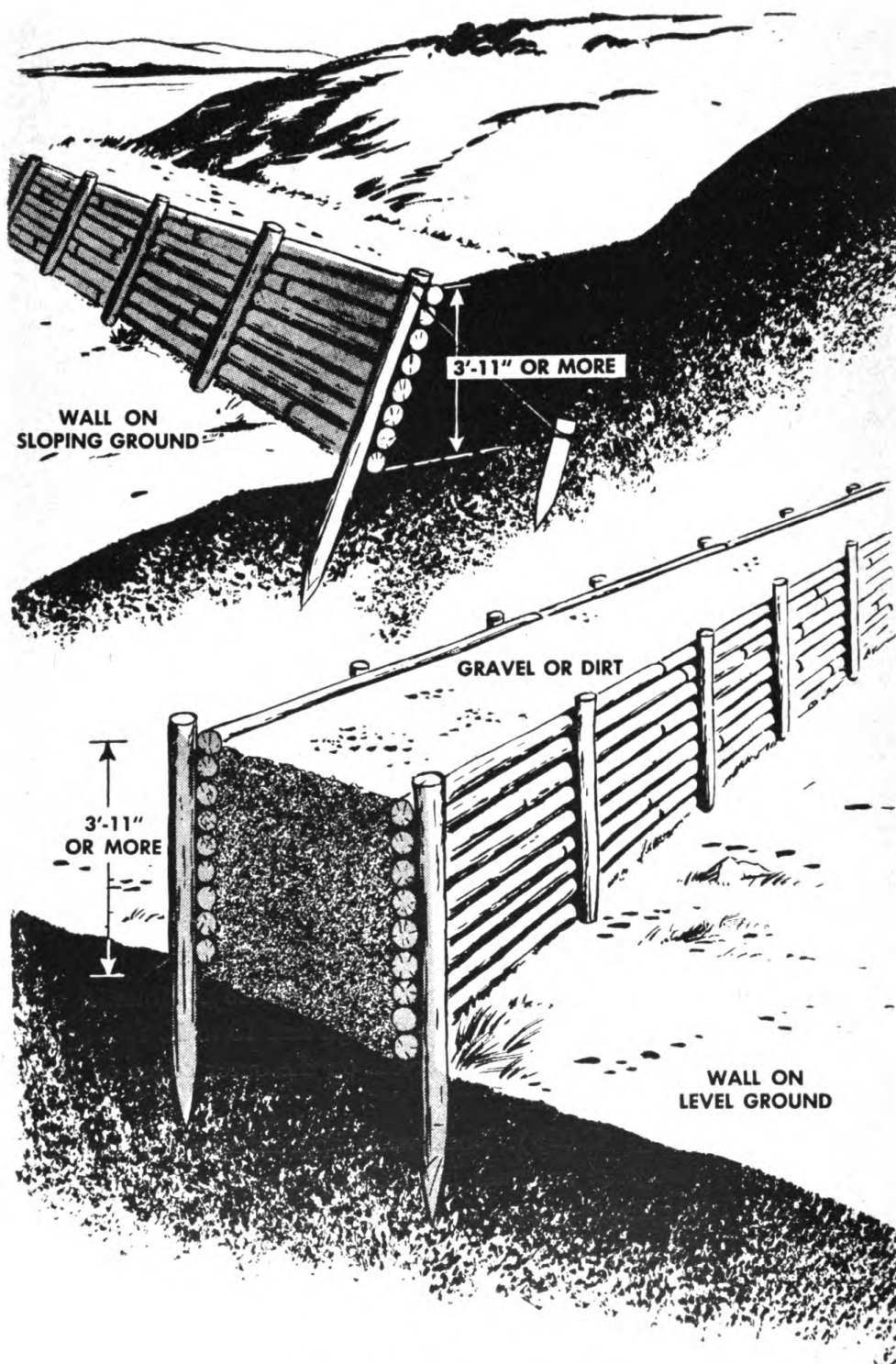


Figure 42.02h. Log-faced walls.

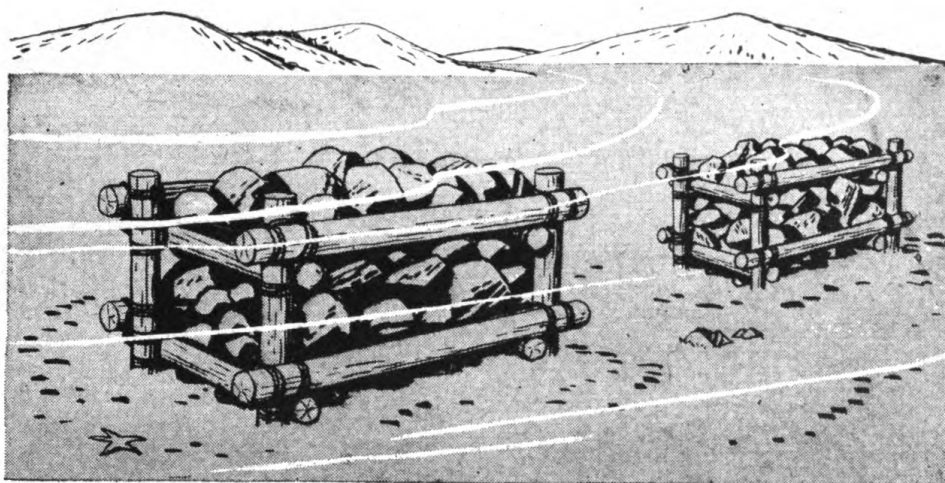


Figure 42.02i. Rock-filled cribs.

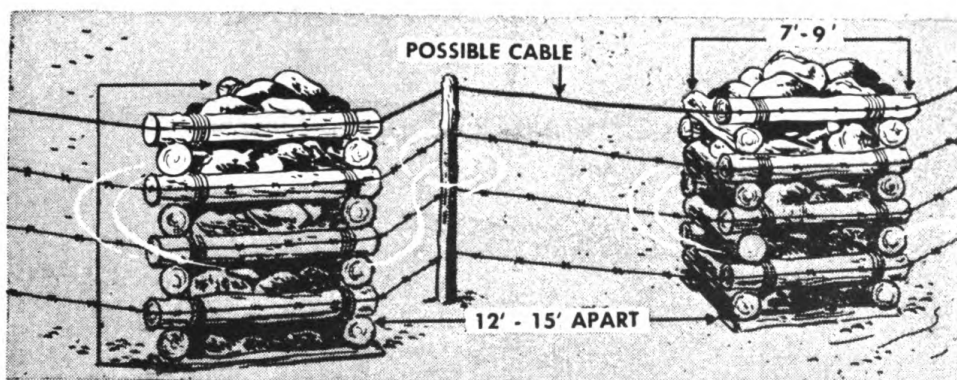


Figure 42.02j. Rock-filled pillars.

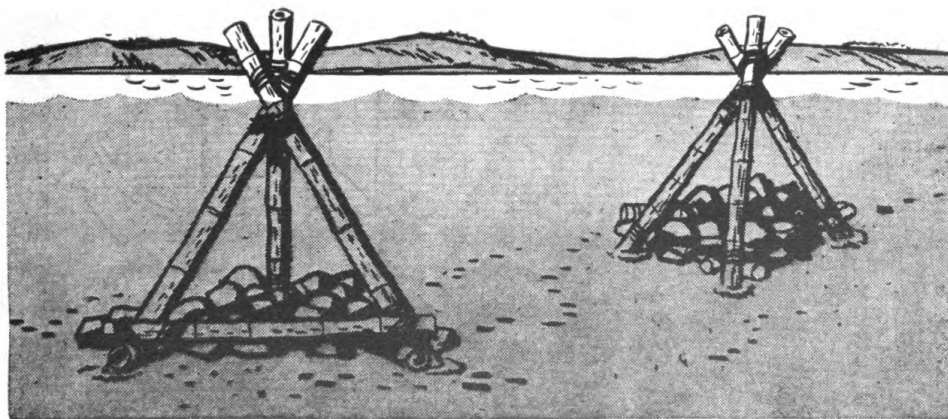


Figure 42.02k. Tetrahedrons.

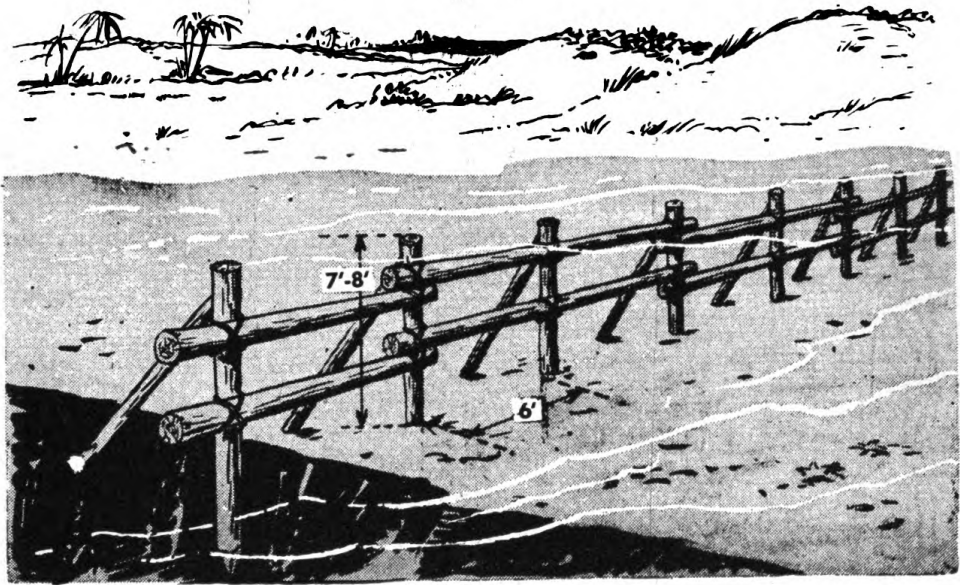


Figure 42.02l. Log scaffolding.

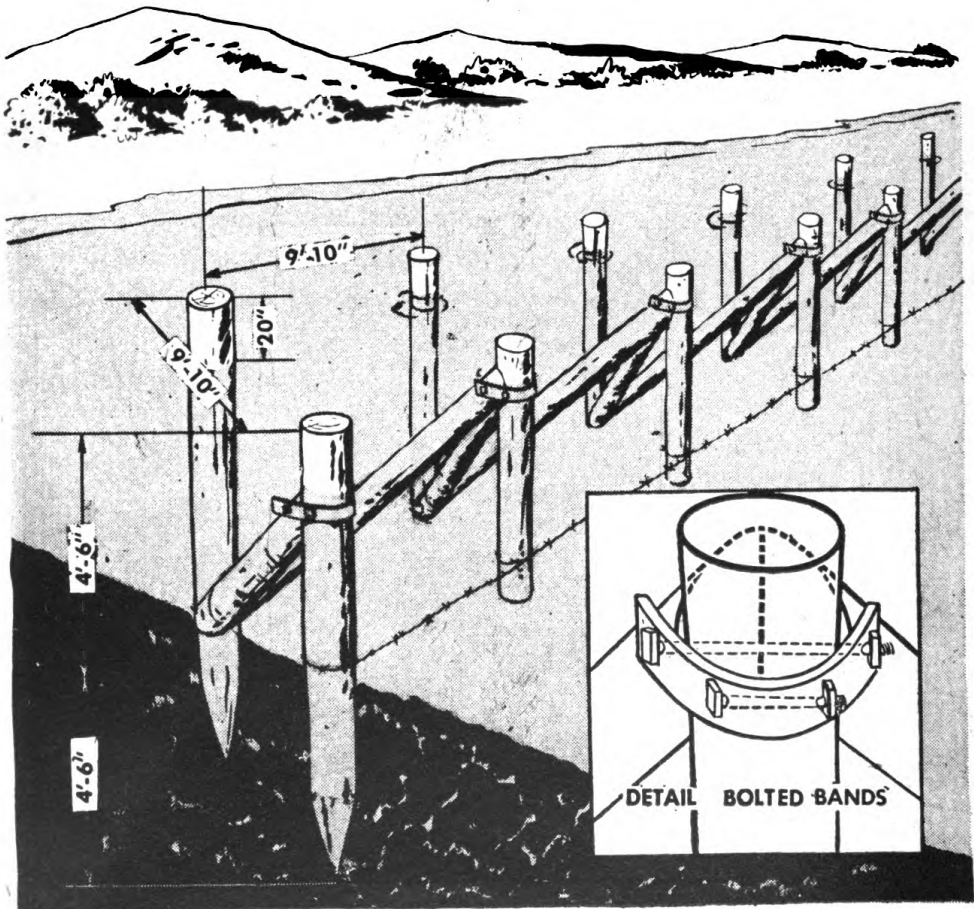


Figure 42.02m. Braced wooden posts.

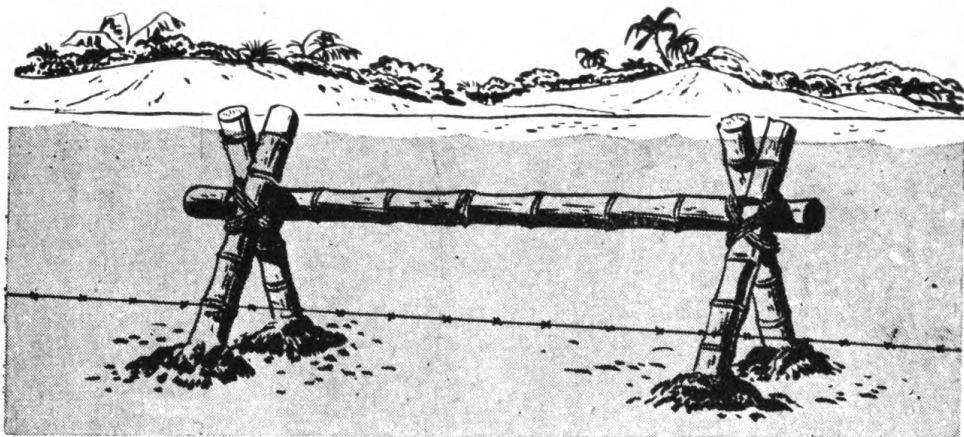


Figure 42.02n. Underwater knife rest.



Figure 42.02o. Rock mounds.



Figure 42.02p. Rock wall.

Section III. HAND-PLACED CHARGES

43.01. General

FM 5-25 contains basic instructions and information on the use of explosives. Paragraphs 21.01 through 21.05 above, cover passage of underwater and beach obstacles. However, additional precautions should be taken to prevent any part of an explosive circuit from becoming wet and failing to fire.

a. **EXPLOSIVE.** (1) The explosive must be suitable for use under water. The principal military explosives, such as TNT, tetrytol, and plastic explosive, are satisfactory under all conditions. Explosives containing ammonium nitrate are not reliable for underwater use unless protected as in 40-pound cans of cratering explosive and in bangalore torpedoes.

(2) The Navy Mark 20 demolition charge (fig. 43.01a), also called the Hagensen Pack, is designed for use in assault demolition of steel, wood, and concrete obstacles where the chief requirement is speed. This charge is a 2-pound 1½- by 2¼- by 12-inch block of composition C-2 contained in a light canvas bag. Five feet of an 11-foot length of detonating cord is folded and molded in the explosive block for priming. The other 6 feet passes outside the bag through a grommet for attaching to a detonating-cord main or a blasting cap. A 3-foot length of sash cord is fastened to one end of the pack and a flat steel hook to the other end for quickly attaching the charge to an obstacle. The Navy Mark 127 demolition outfit (fig. 43.01b) consists of twenty Mark 20 demolition charges, 10 charges packed in each of two pouches of a canvas carrying bag. These charges may be issued to Army units working with Navy demolition teams in demolishing underwater and beach obstacles.

b. **FIRING.** Nonelectric firing is used in the early stages of a landing and in assault blasting. Charges are fired electrically later in the operation, when the attacking force controls the beach. In rough surf, long electric firing circuits (200 feet or more) are unwieldy and hard to handle, and waterproofed nonelectric detonating assemblies (par. 43.03) must be used.

c. **FIRING CIRCUIT.** The firing circuit must be waterproof. Detonating cord ends and joints between fuse lighter and time fuse and between time fuse and blasting cap should be coated with standard issue cap-sealing compound. Asphalt, shellac, or soap may be used as field expe-

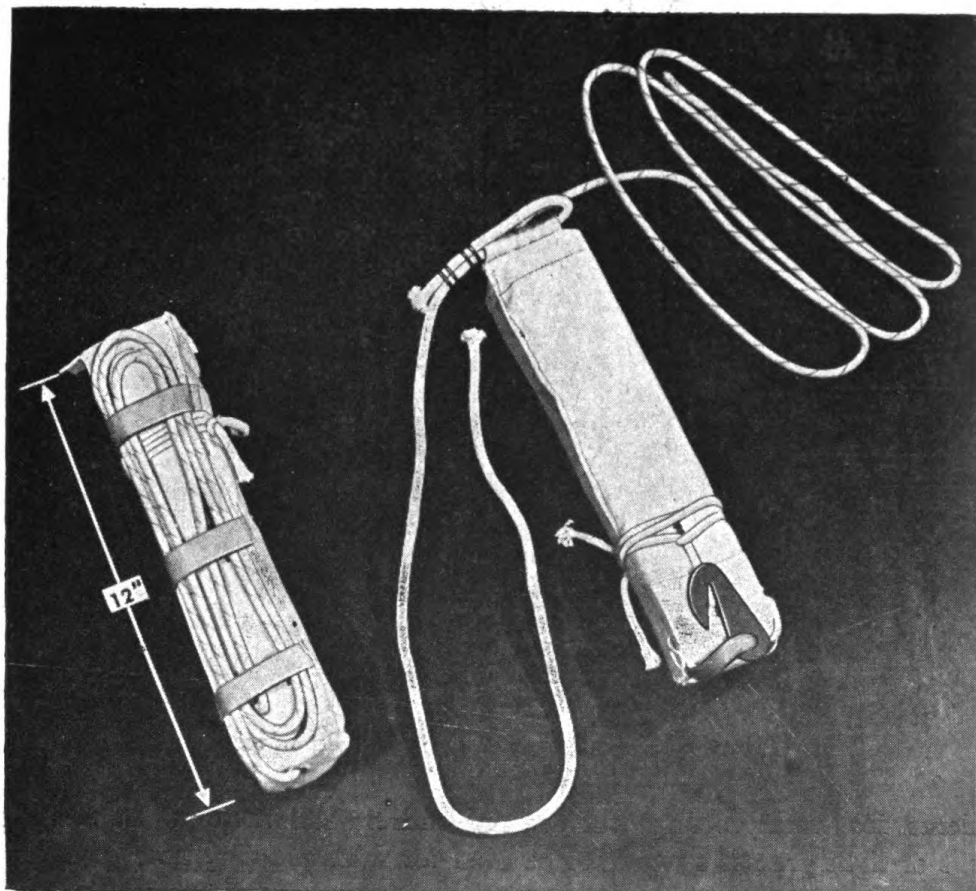


Figure 43.01a. Navy Mark 20 demolition charge.



Figure 43.01b. Navy Mark 127 demolition outfit.

dients for waterproofing, but are not entirely satisfactory. Lubricating oils or light greases should not be used for waterproofing time fuse since they destroy the powder train.

d. WEATHERPROOF FUSE LIGHTER. The M2 weatherproof fuse lighter described in FM 5-25 should be used. The pliable waterproofing material furnished with each M2 fuse lighter is molded over the joint between the fuse lighter and the time fuse. This waterproofing material should be covered with friction tape to prevent its removal by surf or handling before the detonating assembly is fired.

e. CONCUSSION DETONATOR. The M1 concussion detonator, a device actuated by the concussion wave of a blast, can be used to fire several underwater charges simultaneously without interconnecting the charges with wires or detonating cord. Firing a single charge fires all other charges equipped with concussion detonators, providing they are within

range of the main charge or within range of each other. The distances between charges depend on the size of the charges and the depth of the water. Pending incorporation in FM 5-25, more detailed information is presented in TB 5-25-4.

43.02. Demolition of Underwater Obstacles

The following factors must be taken into consideration when breaching underwater obstacles:

a. **TIME ELEMENT.** Breaching continuous underwater obstacles on the scale required in the assault phases of a landing operation is slow and difficult. Detonation of hand-placed charges alerts a defender without clearing gaps adequate for landing craft.

b. **SURF, WIND, AND CURRENT.** The most important adverse factors in hand placing charges are the surf, wind, current conditions, and the difficulty of locating the obstacle. A 3-foot or higher surf makes it extremely difficult for men to place individual charges on underwater obstacles.

c. **USE OF RUBBER BOATS.** Use of rubber boats for placement of charges is not practical in tidal currents of more than 2 miles per hour. The time required with boats is much longer. A rubber-boat crew can place one charge in about 30 minutes in surf in the dark. The charge can be expected to clear an area 25 feet in diameter.

d. **CLEARING FROM SHORE.** Whenever possible, underwater obstructions should be cleared from shore rather than from seaward.

e. **TIME DELAY.** In placing underwater charges, the time of delay between placing and detonation depends on the distance from the obstacle to shore, water depth, surf, current, visibility, and similar conditions. In tests on underwater obstacles about 100 feet offshore in 2- to 3-foot surf, 3 minutes delay has been satisfactory for men working from shore.

f. **POSITION OF CHARGE ON OBSTACLE.** Underwater charges should be placed on the seaward face of most obstacles, since the surf helps hold the charge in place.

43.03. Waterproofed Detonating Assembly

Nonelectric waterproofed detonating assemblies should be prepared beforehand in beach *assault* demolitions. The M1 fuse lighter may be used with the improvised waterproofed detonating assembly but the M2 weatherproof fuse lighter should be used if available.

a. **PREPARING ASSEMBLY.** (1) Insert one end of desired length of time fuse in fuse lighter and other end in nonelectric blasting cap. Crimp cap to fuse, preferably with an M2 cap crimper which crimps a water-resistant groove completely around the cap. Coat both joints with cap-sealing compound. Place prophylactic rubber over fuse lighter, coat

inside of mouth of rubber with cap-sealing compound, and tape open end of rubber to time fuse. Dip both ends of 2-foot length of detonating cord in cap-sealing compound. Tape one end of detonating cord along-side of blasting cap. Coat all friction tape with cap-sealing compound and allow to dry. The detonating cord is omitted from the detonating assembly when the blasting cap is inserted directly into the explosive charge.

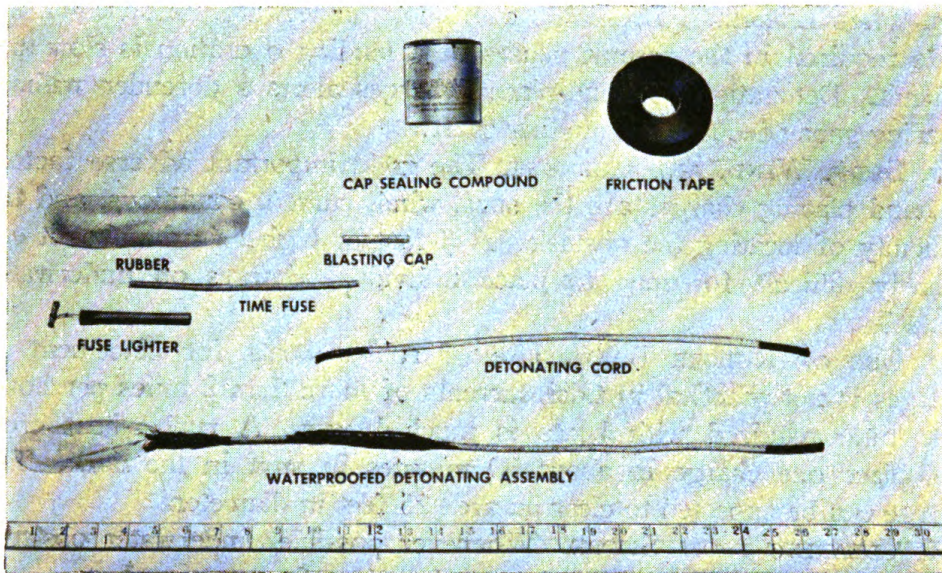


Figure 43.03a. Components and assembled waterproofed detonating assembly.

(2) Although the fuse lighter of this detonating assembly can be pulled under water, it is better to pull it in the air. Improvised detonating assemblies should be handled carefully so the rubber is not broken, the fuse lighter is not pulled accidentally, or other parts of the assembly are damaged.

b. DOUBLE DETONATING ASSEMBLY. To make detonation more certain, two detonating assemblies should be connected to every explosive circuit used in demolitions in landing operations.

(1) A double detonating assembly may be made from two improvised detonating assemblies, each with blasting cap (no detonating cord), by taping one end of a 2-foot length of detonating cord to the blasting cap of one detonating assembly and the other end of the cord to the other blasting cap. The detonating-cord loop then can be attached by a single girth hitch to the detonating-cord main leading to the explosive charges. The advantage is that one simple tie fastens both detonating assemblies to the explosive circuit. (See fig. 43.03b.)

(2) For demolition of obstacles in the water, the waterproof detonating assembly should be attached to a 1-inch board. Such assemblies float

are not so easily lost, and the rigidity of the board reduces the whipping about of fuse in the surf which may cause failure. The board length depends on the length of fuse; a 3-minute time delay can be mounted on a 5-foot, 1- by 4-inch board. (See fig. 43.03b.) For use in the rough seas, it is desirable to attach a cork or board float to the detonating-cord lead to which the detonating assembly is to be attached.

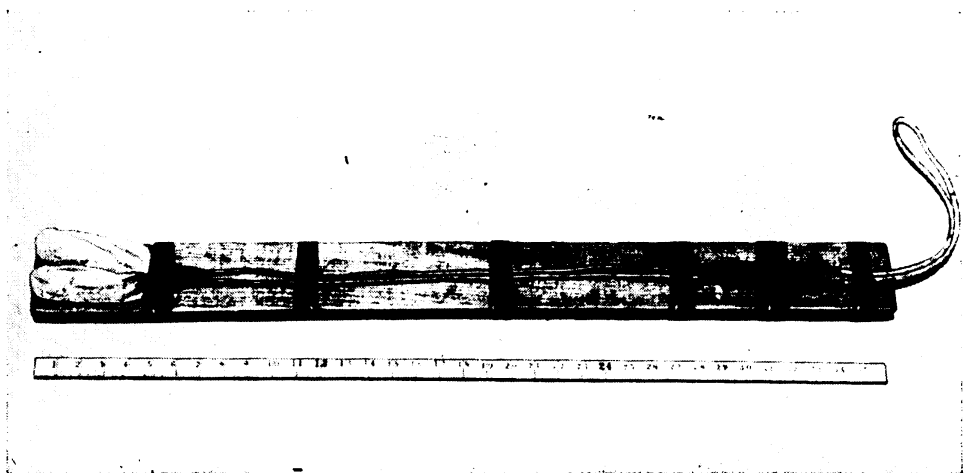


Figure 43.03b. Double detonating assembly.

43.04. Size of Charge for Underwater Obstacles

Typical underwater obstacles are destroyed by the following charges:

- a. STEEL TETRAHEDRON. Single 5-pound charge at apex.
- b. HEAVY STEEL RAIL. One-pound charge at base.
- c. STEEL HEDGEHOG. Five-pound charge at junction of three leg angles.
- d. TWELVE-INCH WOOD PILING. Five-pound charge at base.
- e. JAPANESE HORNED SCULLY. Forty-pound charge on seaward side.

Section IV. BANGALORE TORPEDO

44.01. Barbed Wire

a. UNDERWATER. The bangalore torpedo clears a 10-foot lane through underwater wire, although about 20 percent of the wire is only loosened and not cut, and a sand bottom may be made soft. When the bangalore torpedo is used on underwater obstacles, personnel should take over on the beach or crouch in shallow water with chest, abdomen, and genitals out of the water to avoid injury from concussion.

b. ON THE BEACH. The bangalore torpedo clears a path 10 to 20 feet wide through barbed-wire obstacles on a beach. A well-trained crew can debark from landing craft or rubber boats and place and fire a 55-foot-long bangalore torpedo near the water's edge in 1½ minutes. A drill for breaching wire entanglements on a beach is described below:

(1) SUPPLIES AND EQUIPMENT.

One rubber boat with seven paddles.

Twelve 5-foot sections of bangalore torpedo.

One nose sleeve.

Eleven connecting sleeves.

Two 15-second delay detonators, or, if these are not available, two 15-second waterproofed detonating assemblies.

(2) *Organization of party.* The party consists of a six-man rubber-boat crew with one noncommissioned officer in charge and acting as coxswain. Each man is numbered as shown in figure 44.01. The No. 1 man carries a 10-foot section of bangalore with a nose sleeve on the front and connecting sleeve joining the two 5-foot sections. Men numbered 2, 3, 4, and 5 each carry a 10-foot section of bangalore, with connecting sleeve joining the two 5-foot sections and one on the forward end. The noncommissioned officer and No. 6 man each carry a 15-second delay detonator and a 5-foot section of bangalore with connecting sleeve on the front end.

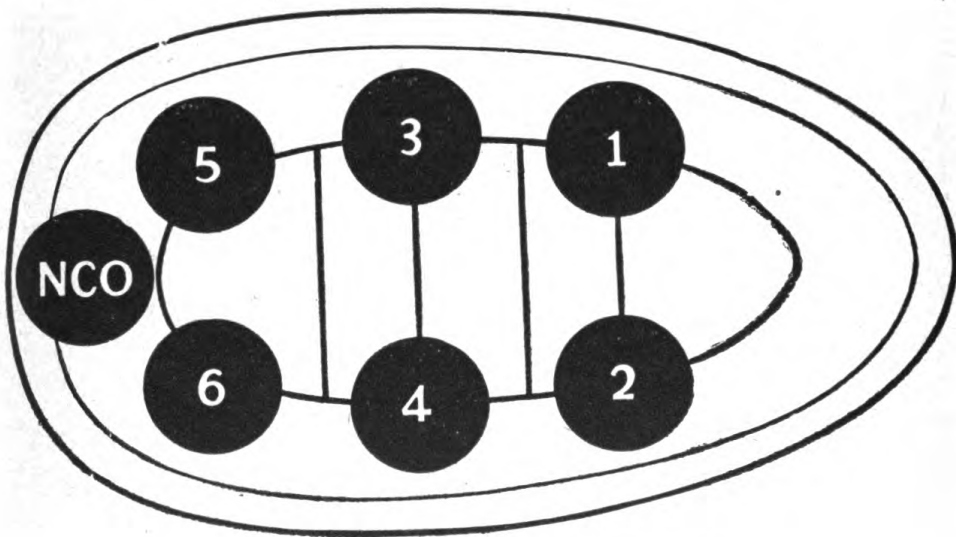


Figure 44.01. Numbering of boat crew.

(3) *Procedure.* (a) On hitting the shore, the crew carry their bangalore torpedoes and disperse on the beach. The noncommissioned officer decides whether to approach the wire by crawling or on the run, makes his way up to the wire, and chooses the location for the bangalore. The rest of the crew make their way up to the noncommissioned officer

one man at a time. The No. 1 man, carrying the 10-foot length of bangalore with nose sleeve, reaches the noncommissioned officer first, pushes his section through the wire, and remains at the wire to push the bangalore through as each section is added. The No. 2 man, on reaching the noncommissioned officer, assists No. 1 man in pushing the bangalore. The noncommissioned officer couples on each section as the men arrive at the fence. The men carry their bangalores with the connecting sleeve on the forward end. Care must be taken not to clog the open sleeve with dirt or sand.

(b) If the men must crawl from their initial positions to the wire, each man carries the bangalore with his hand at the forward connecting sleeve to prevent it from getting clogged with sand. When the bangalore is assembled and pushed through the wire, all men except the noncommissioned officer and No. 6 leave the site and take cover at least 30 yards away or in the water. The No. 6 man inserts his 15-second delay detonator into his torpedo and takes cover. The noncommissioned officer places his 5-foot section alongside the last 5-foot section of the assembled torpedo, inserts his 15-second delay detonator in his torpedo, pulls the safety pins and pull rings of the two delay detonators, and takes cover to await the explosion.

44.02. Log Scaffolding

Against Japanese log scaffolding, nine 5-foot sections of bangalore torpedo are used to make up a charge consisting of three 15-foot lengths of torpedo. The three lengths are tied together and placed at right angles to the line of scaffolding. The number of charges used depends on the width of gap desired. Each charge clears a gap approximately 12 feet wide. Figure 44.02 shows a gap blown by three charges placed on 12-foot centers.

44.03. Steel Scaffolding

Against 2-inch tubular steel scaffolding, twelve 5-foot sections of bangalore torpedo are used to make up a charge consisting of three 20-foot lengths of torpedo. The three lengths are tied together and placed at right angles to the line of scaffolding. The number of charges used depends on the width of gap desired. Each charge clears a gap approximately 15 feet wide.

44.04. Sand Bars

In calm, shallow water, channels can be cleared through sand bars with charges made up of bangalore torpedoes. A method based on the use of bangalore torpedoes from the shore follows:

a. SUPPLIES AND EQUIPMENT.

Eighteen bangalore torpedoes per 5 feet of channel length desired.

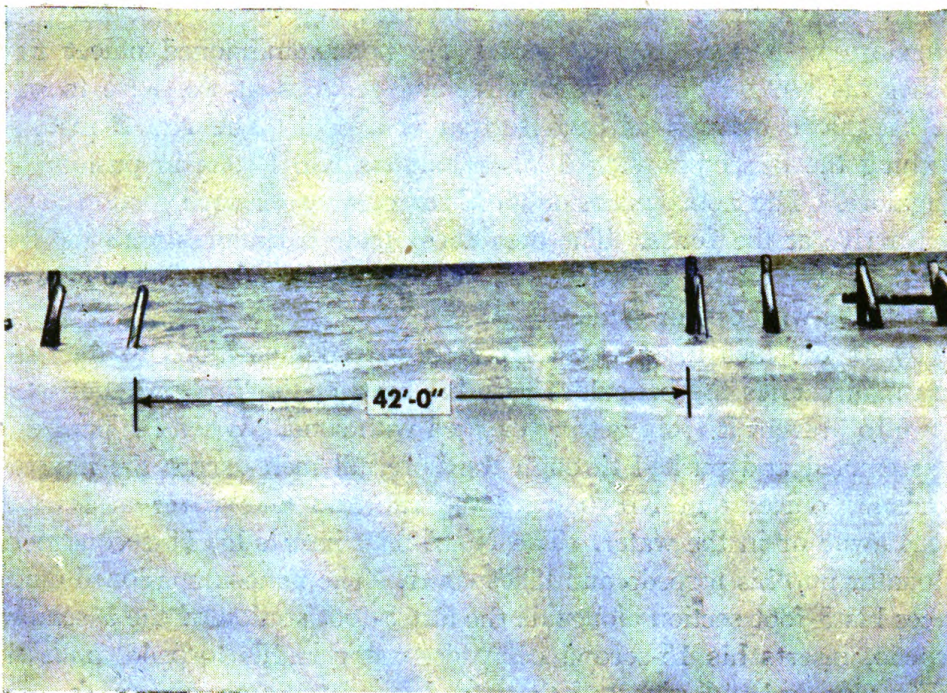


Figure 44.02. Gap through Japanese log scaffolding blown by three 15-foot-long triple bangalore charges placed on 12-foot centers.

Two waterproofed detonating assemblies.

One hundred feet of detonating cord.

b. ORGANIZATION. One platoon.

c. PROCEDURE. (1) Two charges as long as the length of channel desired, each consisting of nine lines of bangalore torpedoes lashed tightly together, are made up on the beach. Joints in alternate lines of torpedoes should be offset. Before placing, a 25-foot detonating-cord loop is attached to each charge wrapping each end of the detonating cord around one torpedo end with a four-loop clove hitch. The wraps are taped. The two charges are then carried one at a time across the sand bar and placed 8 feet apart and parallel. The placing requires one man per 3 feet of charge.

(2) When charges are placed, the two loops are brought together at one point and two detonating assemblies are attached to the two loops so either fires all the lines simultaneously. All except two men leave the water and take cover 100 yards down the beach. These two pull the fuse lighters and then take cover. The resulting blast should produce a channel 35 to 40 feet wide and 4 to 5 feet deeper than the bar.

(3) Charges over 50 feet long are difficult to place. When possible, electric detonating is desirable, and two electric caps in series, instead of detonating assemblies, are taped to the four detonating-cord leads.

(4) The channel should be marked immediately after the explosion.

Section V. NAVY MARK 119 DEMOLITION OUTFIT

45.01. Navy Mark 119 Demolition Outfit (Reddy Fox) (fig. 45.01)

The Navy Mark 119 demolition outfit, also called the Reddy Fox, is an explosive device used to blast gaps for landing craft through underwater obstacles. It is a floating explosive charge which may be assembled in lengths up to 100 feet and loaded with 25 to 40 pounds of explosives per linear foot. Placing the device accurately under fire is difficult. It can be placed by an LCVP which tows it or paravanes it as close as possible to the obstacle. By releasing the paravaning lines or by pulling on

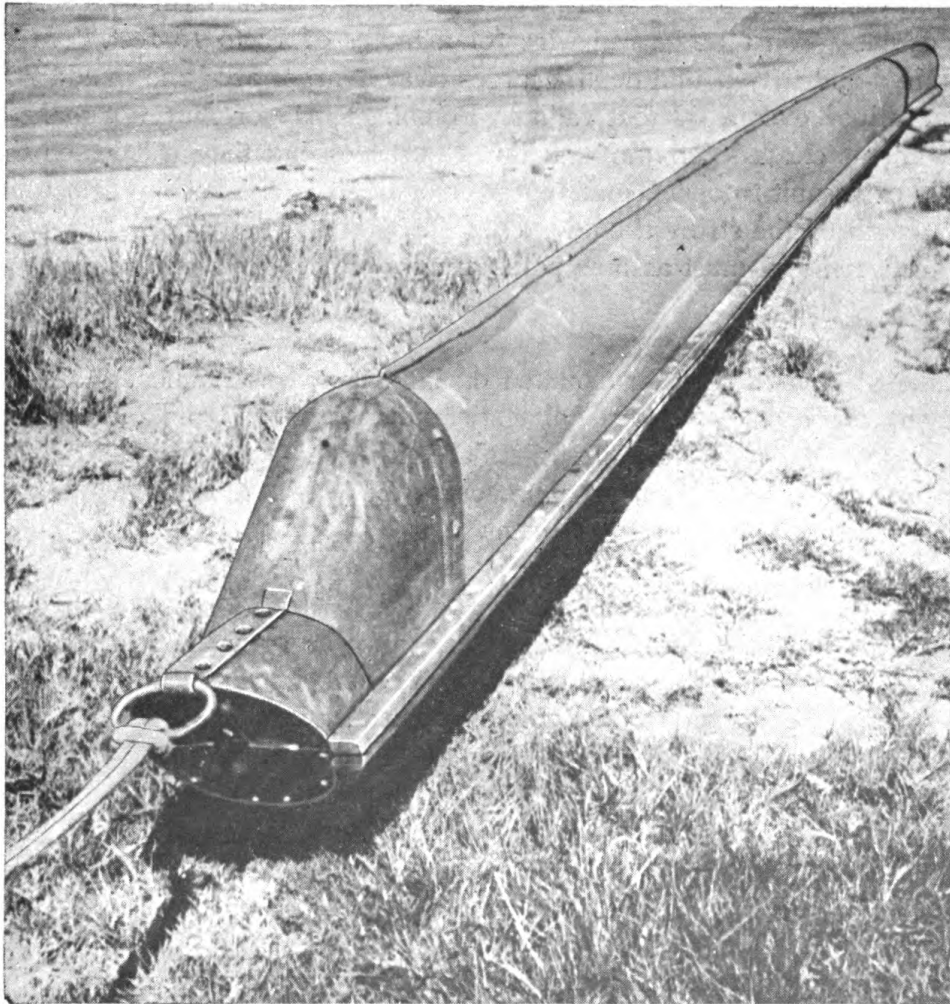


Figure 45.01. Navy Mark 119 demolition outfit.

the stern line tied to the device and passed through a pulley in the bow of the craft, the outfit is projected ahead of the craft into the obstacles. It can also be towed in by LVT's, rubber boats, or by swimmers. It is sunk by firing electrically a strand of detonating cord in contact with the float bags. At the same time a delay fuse is ignited which detonates the main charge. The explosion clears obstacles from a crater 2 to 5 feet deep and 30 to 40 feet wide. Since the Navy Mark 119 demolition outfit is a Navy item, its principal use by Army personnel will be in conjunction with the Navy in clearing underwater obstacles.

Section VI. BOMBARDMENT

46.01. Aerial Bombardment

Aerial bombardment is effective against beach obstacles. One-hundred-pound demolition bombs with instantaneous fuzing will clear concertina- or double-apron type barbed wire for a radius of 12 to 15 feet. Three-hundred-and-fifty-pound depth charges clear a larger area and in addition clear mines over a 30-foot radius. Bombings may or may not make a continuous cleared path through beach obstacles, but they will lessen the tasks of assault troops. To allow for error in placing the string of bombs, the length of the string should exceed the length of the target. Plans for obstacle removal must assume paths are not cleared by bombardment.

46.02. Rocket Fire

Banks of rockets may be mounted on landing craft. Launchers are arranged so rockets can be fired almost simultaneously to form a linear pattern on the ground. Present rockets are either 4.5- or 7.2-inch. Rockets can be fired while the craft is approaching the beach. They have an effect similar to that of aerial bombardment.

46.03. Gunfire

Naval gunfire, like aerial bombardment, may be of value in damaging enemy beach obstacles, particularly wire entanglements; however, the passages will be rough and probably only partially clear.

Section VII. MECHANICAL MEANS OF PASSING OBSTACLES

47.01. General

Generally, equipment and methods of passing obstacles on dry land, described in chapter 3, apply also to beach obstacles above the water's edge.

Equipment such as the tankdozer can be used against obstacles in shallow water.

47.02. Use of Rubber Boats

a. AGAINST UNDERWATER OBSTACLES. (1) Underwater obstacles can be passed by landing assaulting foot troops on the beach in rubber boats. Rubber boats can pass through most underwater obstacles, thus enabling the attacker to put riflemen on the beach to neutralize defending fire. Obstacles can then be cleared without subjecting the clearing personnel to fire from shore.

(2) Standard seven-man rubber boats are 12 feet 5 inches long, have 5-foot 8-inch beam, and weigh 165 pounds. These rubber boats can be maneuvered readily through underwater obstacles such as steel rails or scullies, which normally are spaced on 10- to 15-foot centers. They can be carried by their crews over reefs or sand bars.

b. AGAINST ONSHORE WIRE ENTANGLEMENTS. Rubber boats can be used to surmount wire entanglements. One seven-man rubber boat is required for each 10-foot depth of wire. A path made by rubber boats over wire is more stable than that made by chicken wire. Tests have shown that four rubber-boat crews of seven men have no difficulty in placing the rubber boats over entanglements 40 feet deep in 2½ minutes.

(1) *Supplies and equipment.* Four rubber boats with seven paddles each.

(2) *Organization of party.* Four rubber-boat crews, consisting of six men plus one noncommissioned officer in charge and acting as coxswain. The men in each boat are numbered. (See fig. 44.01.)

(3) *Procedure.* (a) Navy landing craft bring the four rubber boats with crews to a point 200 to 300 yards offshore. Here the rubber-boat crews embark from the seaward side of the landing craft to obtain some cover from fire from the shore. As an alternate method, rubber boats with crews aboard are towed behind a landing craft and are cast off by quick-release devices 200 to 300 yards offshore. The rubber-boat crew crouches low to present as small a silhouette and target as possible. The operation generally is done at night; the rubber boats should keep within 25 yards of each other.

(b) On hitting the shore, the No. 3 and No. 4 men take cover on the beach and give rifle protection. The first boat is overturned by the remaining four men under the supervision of the noncommissioned officer and carried to the barbed wire. The boat is tossed over the wire, bow end first, with its stern covering the first trip wire. Care should be taken that the boat is not thrown over a picket. The No. 1 and No. 2 men take cover on either side to give rifle protection until the entanglement is completely bridged. The No. 5 and No. 6 men place themselves at the bow

of the first boat to assist in placing the second boat on the wire. The non-commissioned officer remains at the site to direct the operation.

(c) By this time the second boat should be landed, overturned, and carried by Nos. 1, 2, 5, and 6 up to the first boat. The noncommissioned officer in charge of this boat and No. 3 and No. 4 take cover on the beach. The four men carrying the boat toss it onto the first boat and No. 1 and No. 2 men take cover on either side. The No. 5 man, assisted by the No. 5 and No. 6 men of the first boat, push the second boat forward. When the second boat is placed with the bow about 6 feet ahead of the bow of the first boat, the No. 5 and No. 6 men crawl over it and move into the wire at the bow. The No. 5 and No. 6 men of both boats then toss the No. 2 boat so its stern just about touches the bow of the first boat. The No. 5 and No. 6 men of the second boat then move into the wire to the bow of the boat.

(d) The procedure for placing the remaining boats is the same as for the second. The No. 5 and No. 6 men move into the wire to the bow of each boat as it is placed. When the four rubber boats are placed across the barbed wire, all men in the wire jump on the rubber boats and cross, the No. 5 and No. 6 men of the last boat being the first to reach the far side of the entanglement. The rest of the boat crews, who have been giving rifle protection, then cross the wire. (See figs. 47.02a, 47.02b, and 47.02c.)

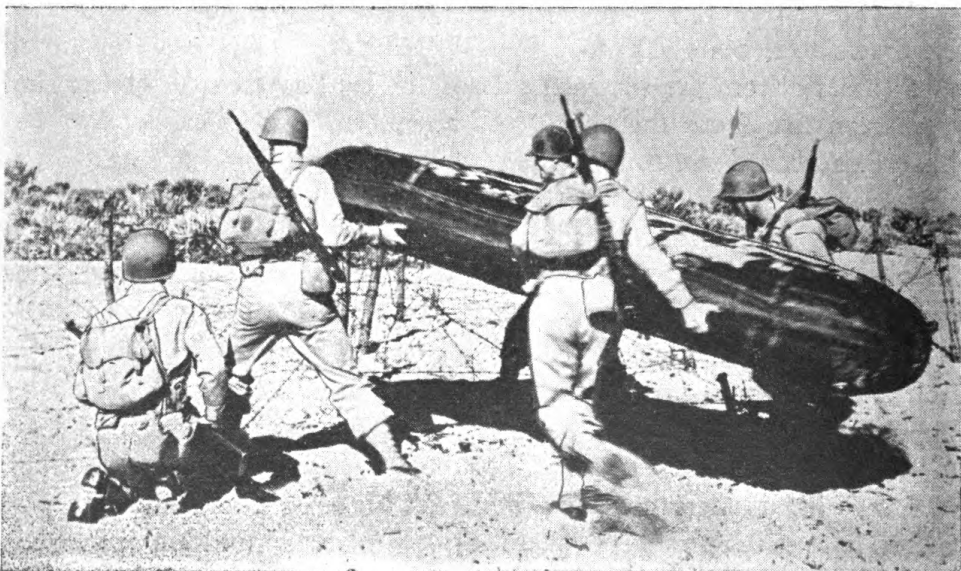


Figure 47.02a. Placing first rubber boat.

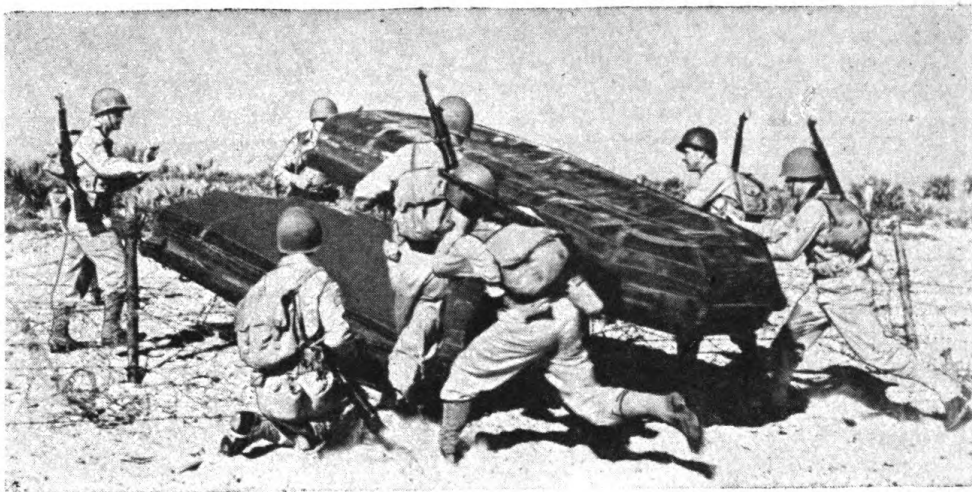


Figure 47.02b. Placing second rubber boat.

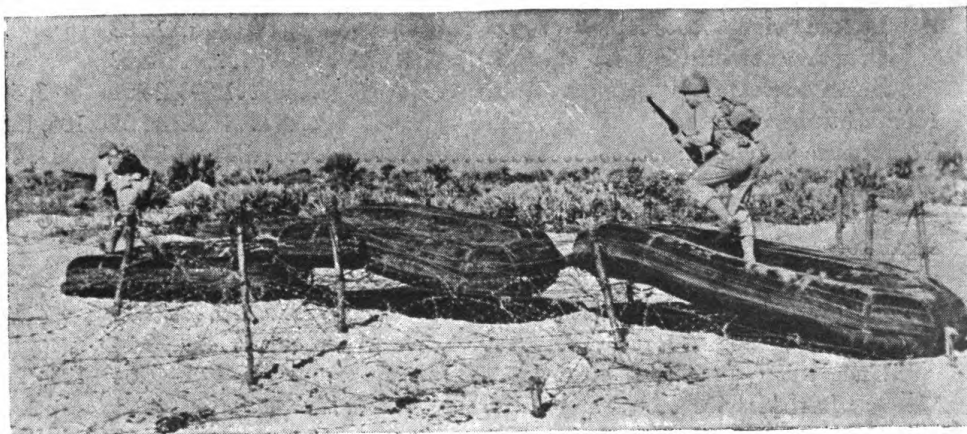


Figure 47.02c. Men crossing rubber boats.

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